MEMBER AUDIT BUREAU OF CIRCULATIONS

THE WELDING ENGINEER

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CONTENTS OF THIS ISSUE

Record Attendance at Atlantic City A.W.S. Meeting....21

What About Preheating?....26

Prominent Fabricator Reviews Work in Welding Large Structures....29

Welding in Tanker Construction....36

Resistance Welding Expands Its Field of Usefulness...42

Chicago Revises Building Code to Permit Structural Welding....49

Welding Has a Real Future (Editorial). 19
The Story of Acetylene.... 35
Welding Applications in the Specialty Field.... 45
Production of Brewery Equipment.... 46
British Hold First Welding Exposition.. 46
New Equipment Developments.... 47
News of the Industry.... 50
Construction News.... 51
A.W.S. Activities.... 52
Trade News.... 53
Trade Literature.... 56
Job Welding News.... 57
Obituary.... 58
Classified Ads.... 59

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INDEX TO ADVERTISERS

A

Air Reduction Sales Co. ... 18
Adams & Co., J. D. ... 55
Aladdin Rod & Flux Mfg. Co. ... 66
American Agile Corp. ... 65
American Brass Co. ... 53
American Solder & Flux Co. ... 64
American Steel & Wire Co. ... 11
American Welding Society ... 10
Anti-Borax Compound Co. ... 64
Arcos Corp. ... 66

B

Bastian-Blessing Co., The ... 6
Black & Decker Mfg. Co. ... 13

C

Carnegie-Illinois Steel Corp. ... 11
Central Steel & Wire Co. ... Third Cover
Chase Brass & Copper Co., Inc. ... 10
Chicago Hardware Foundry Co. ... 65
Chicago Steel & Wire Co. ... 62
Churchward Engineering Co., Inc. ... Fourth Cover
Classified Ads ... 59
Cleveland School of Welding, Inc. ... 59
Columbia Steel Co. ... 11
Commercial Acetylene Supply Co., Inc. ... 65

E

Eisler Engineering Co. ... 66

F

Faulk, F. R. ... 64

G

General Electric Co. ... Second Cover

H

Handy & Harman ... 57
Harnischfeger Corp. ... 9
Hobart Brothers ... 3

I

Ideal Face Shield Co. ... 64
Imperial Brass Mfg. Co. ... 64

J

Jackson Electrode Holder Co. ... Third Cover

L

Lincoln Electric Co., The ... 7
Ludlum Steel Co. ... 63

M

Mark Twain Hotel ... 62
Metal & Thermit Corp. ... 15
Metal-Bond Mfg. Co. ... 66
Milburn Co., The Alexander ... 66

N

National Carbide Corp. ... 62
National Tube Co. ... 11

O

Okonite Co., The ... 54
Owen Electric Sales Co. ... 59

P

Page Steel & Wire Division ... 12
Pierce Governor Co. ... 61
Pratt & Whitney ... 20

R

Revere Copper & Brass, Inc. ... 62
Roeblings Sons Co., J. A. ... 4
Ryerson & Sons, Inc., Jos. T. ... 56

S

Safety Gas Lighter Co. ... 58
Shawinigan Carbide Corp. ... 66
Shoot-A-Lite Corp. ... 66
Steel Sales Corp. ... 61
Stoody Co. ... 17
Stulz-Sickles Co. ... 62

T

Tennessee Coal, Iron and Railroad Co. ... 12
Torchweld Equipment Co. ... 65
Torit Mfg. Co. ... 66
Tweco Products Co. ... 63

U

U. S. Steel Products Co. ... 12

V

Victor Equipment Co. ... 8

W

Westinghouse Electric & Mfg. Co. ... 14

WELDING HAS A REAL FUTURE

IN SPITE of the current recession in business activity, particularly the sharp decline in steel production, anyone close to the welding field cannot help but be optimistic as to its future. Those who attended the technical sessions of the American Welding Society at Atlantic City, the welding exhibits at the National Metal Show, and the technical sessions of the International Acetylene Association at Birmingham, were certainly impressed by the number of promising developments in welding and cutting.

Rapid strides are being made in the economical fabrication of heavy structures from rolled steel plates and structural shapes. In this work the electric arc and oxy-acetylene flame-cutting machine are indispensable tools. One of the most interesting papers at the Welding Society meeting described how heavy electrical machinery is now fabricated by welding with very definite advantages from the standpoint of design, plant investment and flexibility. It has been estimated by experienced welding men that welding rod consumption can be increased about 50 million pounds per year as more machinery fabricators turn to welding. Similarly, it will step up the market for steel plates and shapes about 1,500,000 tons annually and will create an increased demand for bending brakes and other forming machines, air tools, material-handling equipment, preheating and stress-relief annealing furnaces.

Structural welding is definitely on the increase. New York City a few months ago, led the way by adopting a new building code which permits the use of welding in the construction of steel buildings. Early this month Chicago fell in line by revising its building code so as to permit structural welding. This represents a substantial engineering victory because it is anticipated that other big cities will fall in line rapidly now that the two largest cities in the country recognize the importance of welding in steel construction.

As railway equipment builders extend the use of welded fabrication, it is estimated that an additional 15 million pounds of welding rod will be consumed per year. Development has been rapid in this field, because of the definite operating advantages with light-weight construction. The new low-alloy steels and stainless steels are being used quite prominently, experience indicating that they are really fool-proof steels in so far as weldability is concerned. Resistance welding is playing an increasingly important part in railway equipment fabrication.

In the petroleum industry, pipeline fabrication is almost exclusively by use of welding. Recently a new development has appeared—the welding of oil well casing. As this practice becomes more generally adopted, it will expand the market for welding rods about 10 million pounds annually, according to experienced observers. Hard surfacing applications really began in the oil fields. Drilling operators are constantly increasing their use of hard surfacing to lengthen the life of drill bits and what is more important, to maintain continuous high-speed operation.

It is evident that industry is rapidly increasing the use of low-temperature brazing, particularly electrical manufacturers and contractors. This rapid increase is due largely to the development of new alloys, with melting points as low as 1175 deg. F. Improvement in brazing fluxes is another factor stepping up the application of this process. Brazing operations are comparatively simple and operators without any previous experience with the oxy-acetylene blowpipe have given a good account of themselves when put to work on brazing jobs. At the I.A.A. meeting in Birmingham, an electrical contractor related how economically a huge copper bus bar structure was brazed in connection with the construction of galvanic pickling equipment for a large steel mill. The cost of installation was more than 50 per cent less than the conventional method of bolting bus bars.

Electrical manufacturers are turning to low-temperature brazing and resistance welding, rather than soft solder, because of the higher operating temperatures their equipment will then withstand. A steel mill electrical engineer reported recently that he now runs squirrel-cage inducion motors at such a high temperature that the mill superintendent gets excited every now and then, thinking that the motors will burn out. But, with the newer heat-resistant electrical insulation and silver brazing alloys, electrical capacity has been stepped up beyond the A.I.E.E. standard of 40 deg. C. temperature rise.

This is the Kellerflex JF-3, with a half horse power motor, and speeds up to 5600 R.P.M. It is an ideal machine for a welding shop—easily portable from one job to another, and with plenty of power. Its height is adjustable to suit the operator and the job.

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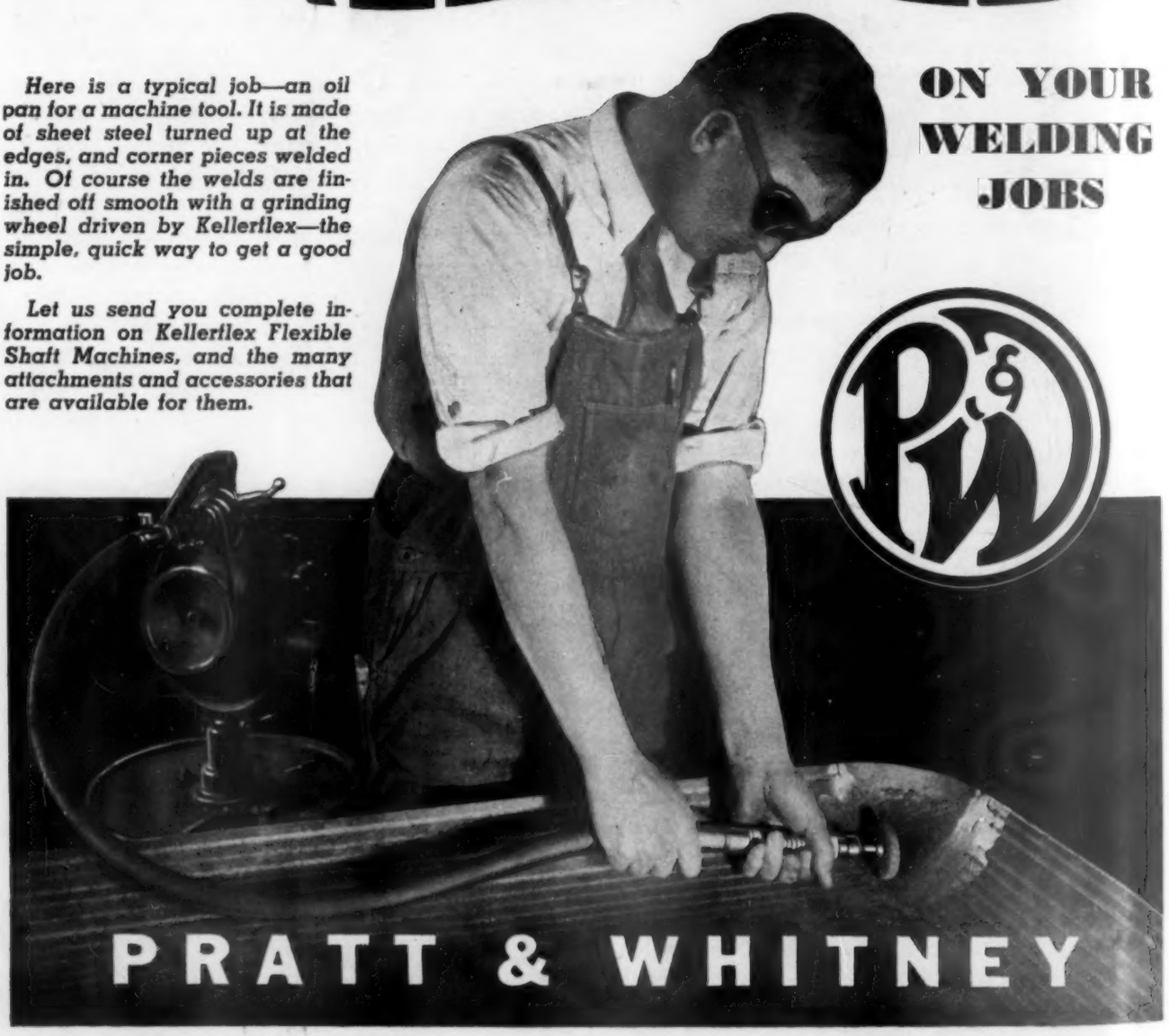


PRATT & WHITNEY

Record attendance at

Atlantic City A.W.S. Meeting

Retiring President Gibson predicted still greater progress for the Society in 1938

From left to right—P. G. Lang Jr., new president of the Society; A. E. Gibson, past president; Colonel G. F. Jenks, new senior vice-president

OVER 1,000 welding engineers, supervisors, and people interested in welding attended the technical meetings of the American Welding Society at the Hotel Traymore, Atlantic City, N. J., October 18-22. This was the 18th annual meeting of the Society held in conjunction with the National Metal Exposition. The number of exhibitors of welding equipment exceeded that of previous years. The total registration at the Metal Exposition was 10,850. This year's convention was considered to be one of the most outstanding in the history of the American Welding Society. A total of 31 papers, dealing with research, fabrication, alloy steels, railroad equipment and shipbuilding were presented at the technical sessions. We published brief abstracts of most of these technical papers in our October issue. In this issue we present two of the outstanding papers. It is regretted that space does not permit including more of these excellent papers.

At the Monday morning business session, October 18th, President Gibson in his report outlined the activities of the various committees which have been active during the past year, pointing out the tremendous strides made by the Welding Society in the preparation of procedure codes, and in cooperating with other engineering societies to further the adoption of welding in industry. He reported very gratifying progress during the past year in attainment of the Society's objectives and predicted still greater progress during 1938. President Gibson reported an increase in local sections from 12 to 23 and a gain of nearly 100% in membership, indicating the widespread industrial acceptance of welding. Other evidences of progress made by the Society the past year are: obtainment of larger quarters for the operating personnel, increase in clerical help necessitated by the enlarged membership and employment of a managing director.

In technical work, many new codes have been written or revised and the Society, through its members, has played an important role in the fundamental research program sponsored by the Engineering Foundation under the able direction of Dr. Comfort Adams, consulting engineer. Some of these increased activities and facilities have been made possible, said Mr. Gibson, by industrial concerns which have underwritten the society's program.

Lincoln Gold Medal Award

A high point of interest in the Monday morning meeting was the presentation of the Lincoln Gold Medal to T. M. Jackson, electrical and welding engineer, Sun Shipbuilding and Dry Dock Co., Chester, Pa. The medal was awarded Mr. Jackson as author of the best paper on welding, published in the Journal of the Society, during the past year ending with the Society's annual meeting. Mr. Jackson's paper, "Welding in Tanker Construction" is a comprehensive exposition of the subject, and is reprinted almost in its entirety elsewhere in this issue. His paper covers the use of electric welding in construction of tank vessels, giving some of the history of the welding of vessels, describing in considerable detail the construction of an 18,000-ton tanker by electric welding and pointing the way to future development of welding in the field of vessel construction. Mr. Jackson has been with the Sun Shipbuilding

and Dry Dock Co. for 19 years. He is a graduate of Cornell University and is chairman of the Philadelphia Section of the American Welding Society.

Miller Memorial Medal

Another feature of the business session meeting was the award of the Samuel Wiley Miller Memorial Medal to H. Sidney Smith, consulting engineer, International Acetylene Association, New York. This award was made "for meritorious achievement contributing conspicuously to the advancement of the art of welding and cutting." Well-known in the acetylene industry, both in America and abroad, H. Sidney Smith has served as president of both the British Acetylene Association and the International Acetylene Association and has been directly responsible for many important developments in acetylene utilization. Born in Newark, England, he was educated as an electrical engineer at Nottingham University.

In his long and active career with Union Carbide Co. and its associated companies, he has made many important contributions to the oxy-acetylene industry, and has been the author of many technical articles on the uses of oxygen, acetylene, calcium carbide and oxy-acetylene apparatus.

Annual Dinner

The high spot of the annual dinner Thursday evening, held in the Submarine Grill, Hotel Traymore, was an entertaining parody entitled "Fusion Welding of Organic Materials," by a Dr. McPherson, "noted research engineer of San Diego, Calif." He was introduced to the audience with a flourishing professional build-up, but it was not very long before some engineers in the audience began to doubt the seriousness of Dr. McPherson's message. It was later learned that Dr. McPherson was none other than Phil Swayne, editor of POWER.

The progress made by the Welding Society through the activities of its various technical committees is briefly reported in this issue.

Colonel G. F. Jenks awards the Lincoln Gold Medal to T. M. Jackson

Dr. Comfort A. Adams awards the Miller Memorial Medal to H. Sidney Smith

Building Code

The committee continued its cooperation with a special engineering committee concerned with the progress of the New York City Building Code. The enactment by New York City of the new building code is one of the achievements of this committee. Numerous inquiries from individuals and organizations, including building officials and committees of other societies, have been answered by the building code committee. It has collected a vast amount of information as to the status of welding in the building codes of several cities. The committee has worked toward the adoption of a schedule of higher design stresses for welds made with high strength filler metal and has worked toward the adoption of better test qualifications for welding operators.

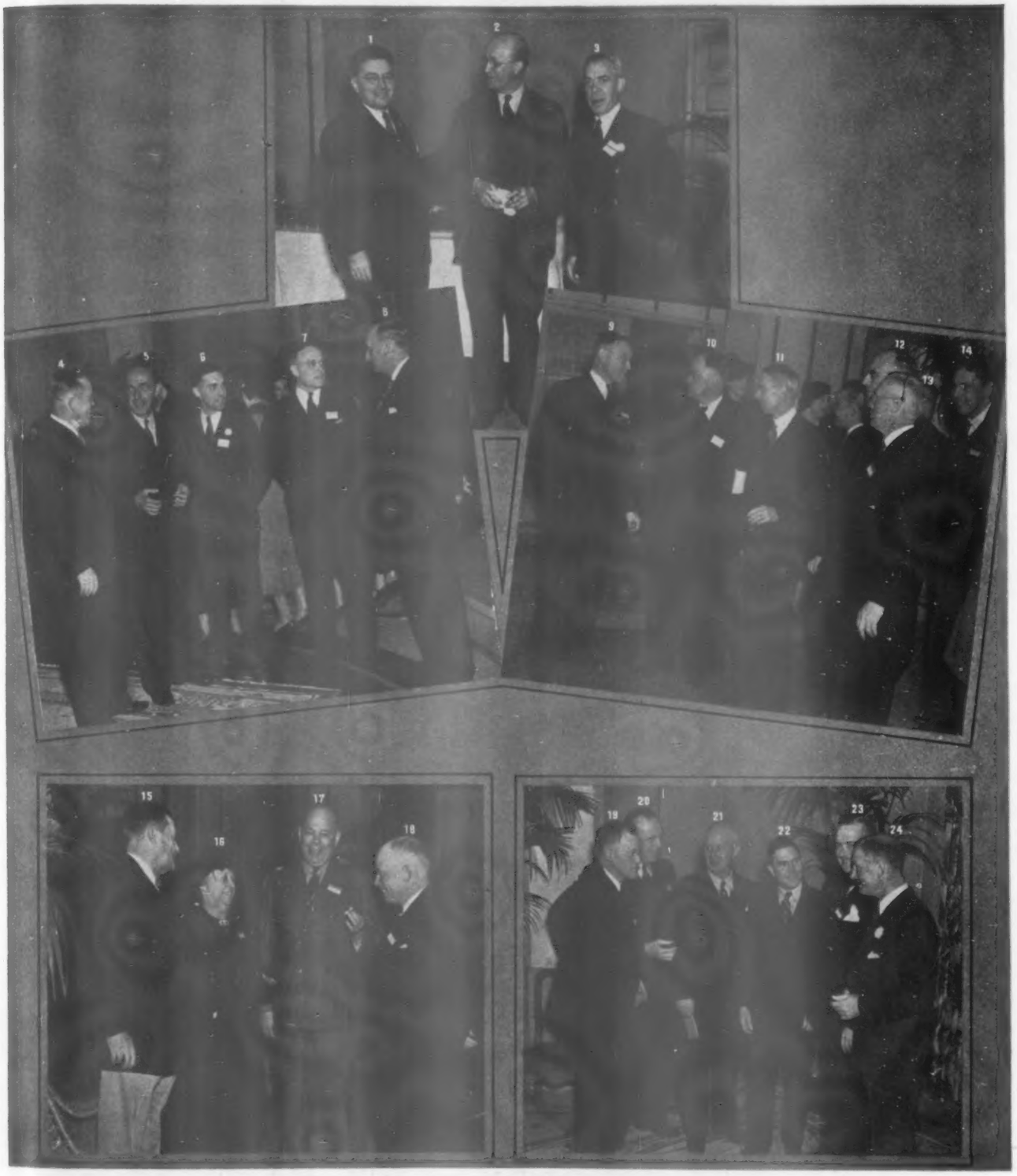
Bridge Building

The conference committee on welding of bridges has directed its efforts toward: (1) Qualifying points in the specifications which may be questioned in practical application, (2) Securing the adoption of the A.W.S. bridge specification by professional bodies throughout the country. As a result of concerted effort on the part of this committee, the A. W. S. bridge specification is being brought to the attention of the engineering profession. It is being tested in actual practice and the lessons of experience studied and a systematic effort

is being made to bring these bridge specifications to as near a state of perfection as possible. It is significant that the American Railway Engineering Association has definitely recommended the A. W. S. bridge specification for adoption at its next meeting in March, 1938. It is expected that this will result in more activity in welded bridges, bringing this country ahead of similar activity in some European countries.

Welding Symbols

The committee reported that the revised welding symbols have been adopted by various technical bodies and have been offered to the American Standards Association for adoption as an American engineering standard. Many copies of the Society booklet have already been sold, and this is indicative of the interest in this new activity.



Our Atlantic City photographer snapped these folks at the President's reception Sunday, October 17th

(Identification by Walter Winchell): 1—J. W. Meadowcroft; 2—C. A.Adams; 3—C. A. McCune; 4—C. A. Loomis; 5—J. H. Deppeler, Sr.; 6—Milton Male; 7—N. F. Ward; 8—F. H. Franklin; 9—N. F. Ward; 10—A. F. Davis; 11—R. D. Thomas; 12—A. G. Bissell; 13—T. M. Jackson; 14—K. K. Madsen; 15—F. T. Llewellyn; 16—Mrs. E. A.Doyle; 17—E. A. Doyle; 18—J. B. Tinnon; 19—A. F. Davis; 20—B. W. Farquhar; 21—O. B. McLaughlan; 22—C. M.Cockerel; 23—Pierre Champion; 24—A. E. Gibson

P. G. LANG, JR.

The election of Mr. Lang to the presidency of the American Welding Society recalls to mind the effective work he did as chairman of the conference committee which developed specifications for the design, construction, alteration and repair of highway and railway bridges by fusion welding.

Mr. Lang was born on September 24, 1883, at Philadelphia. He is a graduate of the University of Pennsylvania, 1905, and entered railway service in 1906. Since December, 1907, Mr. Lang has been connected with the Baltimore & Ohio Railroad, serving in various engineering capacities. In April, 1921, he was appointed engineer of bridges and has continued in this position.

Oil Storage Tanks

The committee stated that its report was not final in that agreement had not been reached on all the details. Preliminary report did not specify any definite amount for working stresses in the shell plate. The Board of Directors referred the report back to the committee to agree upon a definitely specified working stress and suggesting a conservative value of 18,000 lbs. rather than the 21,000 lb. figure desired by the petroleum industry. The committee's problem is to obtain agreement on this point.

Testing of Welds

The committee in charge of this work has endeavored to harmonize the many minor variations now existing between details of weld testing methods. Some of these details are of a minor nature, but they prevent tests carried out under one specification from being exactly applicable under a second specification. A tentative draft has been prepared and submitted to committees sponsoring various fabrication specifications and it is hoped that an agreement can be reached which will provide industry with a standard method of testing welds.

At the round table discussion on qualification of welding operators, it was brought out that while most engineers are satisfied with the nick-break test to determine soundness, others feel that some sort of a bend test is necessary.

Welding Research Activities

Dr. Comfort A. Adams, chairman of the Welding Research Committee, Engineering Foundation, outlined the program of his committee. Briefly, activity has been divided into three divisions: (1) Literature, (2) Fundamental Research, and (3) Industrial Research. In the Literature Division, Dr. Adams pointed out that a total of 32 reports, comprising 368 printed pages were published in THE WELDING JOURNAL during the past year. A total of $17,000 was raised in 1936 to carry on the work of the Welding Research Committee. He mentioned that $10,000 a year for the next three years will be expended on an industrial research program to determine the fatigue strength of large welded connections. Dr. Adams pointed out that 90 per cent of this money will come from users of welding and 10 per cent from manufacturers of welding equipment. Another project under way concerns an investigation of resistance welding at the Rensselaer Polytechnic Institute, Troy, N. Y. The money available permits the full-time employment of one research assistant.

A. W. S. Convention Committee

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General Chairman

W. S. HAYS
Managing Director

M. M. KELLY
Secretary
American Welding Society

J. B. TINNON
Chairman, Manufacturers Committee

E. V. DAVID
Chairman
Technical Program Committee

T. M. JACKSON
Chairman, Philadelphia Section

H. E. HOPKINS
Secretary, Philadelphia Section

J. W. MILLER
Chairman, Maryland Section

C. N. HILBINGER
Secretary, Maryland Section

T. M. JACKSON

Mr. Jackson, winner of the Lincoln Gold Medal award, has been connected with the Sun Shipbuilding and Dry Dock Co., Chester, Pa., for 19 years. At the present time he is the electrical and welding engineer of this company. Mr. Jackson is a graduate of Cornell University and is chairman of the Philadelphia Section of the American Welding Society.

Educational Committee

This committee has prepared an outline of a lecture course for the benefit of various Sections of the Society. A series of four lectures is recommended dealing with welding fundamentals and the more common base materials. Following this, the committee is in position to supply additional lecture material on special matters of greatest local interest to the Section. Another contribution of this committee is the furnishing of lecture notes to any person assisting in the presentation of the course. Another activity of the educational committee is a survey now being made of speakers and movies available for lectures and meetings, and a study of welding educational facilities afforded by technical schools, trade schools, welding clinics and industrial schools.

Membership Growth

Chairman A. F. Davis, of the membership committee, reported almost doubling the membership since October, 1936. The latest statistics of October 1st indicate 2,541 members. President Gibson pointed to this as a real achievement and stated that the Society is headed for another doubling of its membership, claiming that the Society will have 5,000 members by October, 1939. At any rate, it is believed that 3,000 members are practically assured by January, 1938. Rapid growth of membership has been made possible largely because of the many new Sections which have been established. It is necessary to have 25 or more members before a Section of the Welding Society can be established.

Newly Elected A. W. S. Officers:

P. G. LANG, JR., president
Baltimore, Md.

COL. G. F. JENKS, senior vice-president
Washington, D. C.

W. J. SANNEMANN, Southern Divisional vice-president
Birmingham, Ala.

K. V. KING, Pacific Coast Divisional vice-president
San Francisco, Calif.

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A. M. CANDY, Chicago
J. H. DEPPELER, New York
E. R. FISH, Hartford, Conn.
A. E. GAYNOR, New York
L. S. MOISSEIFF, New York

At the Atlantic City meeting the latest information on local Sections revealed 23 established as against 12 a year ago. One of the newest Sections in St. Louis reported a phenomenal attendance at a recent meeting. It was claimed that over 1,000 people attended the Section meeting in St. Louis.

President Gibson's Farewell

In concluding his report President Gibson remarked: "Your president appreciates very keenly the splendid cooperation which has been given him by the employees of the Society and the general membership. Without the willing and effective cooperation of our members little progress could have been made. While the growth in Sections and membership and the splendid technical work of the many committees have resulted in gratifying progress, the results which will be obtained in the coming year will without question far surpass anything we have had heretofore.

"I have thoroughly enjoyed my year as president of your Society and very reluctantly hand over the reins to my successor, but I do so with absolute confidence in his ability as a leader who will obtain excellent results during his term of office. In resuming my place as simply a member of the Society, I do so with the hope that I shall be called upon to assist in the future work, whenever my services can be of value to the Society."

H. SIDNEY SMITH

Mr. Smith, winner of the Samuel Wiley Miller Medal, is a well known figure in the oxy-acetylene industry, having served as president of both the British Acetylene Association and the International Acetylene Association. Mr. Smith has been directly responsible for many important developments in gas welding and cutting. Born in Newark, England, and educated as an electrical engineer at Nottingham University, he has spent most of his long and active career with the Union Carbide Company.

New President Introduced

Mr. Gibson then introduced the new president of the American Welding Society, P. G. Lang, Jr., engineer of bridges of the Baltimore & Ohio Railroad. In accepting his new responsibilities, President Lang stated: "There has been a continued and healthy growth in the Society since its inception 19 years ago. This is particularly evidenced by the minor effect which the late depression had. Since 1933 there has been a continued and accelerated growth." Continuing, Mr. Lang suggested "Membership solicitation should be largely confined to engineers, executives, supervisors, instructors and selected welding operators, who are interested in the science and art of welding from the engineering, design, and managerial phases."

Mr. Lang emphasized the distinction between a technical society and a trade association, indicating that a trade association "needs a technical society, separate and independent, which will prepare after thorough study of all available data, necessary codes, specifications, and rules of recommended procedure and practice. The American Welding Society, in President Lang's opinion, "will continue to be of vast help to the welding industry, both manufacturers and users."

Edward G. Budd Speaks

A feature of the opening session of the annual meeting was an interesting non-technical address by Edward G. Budd, president of the Edward G. Budd Manufacturing Co., Philadelphia. Mr. Budd commented on the fact that too many unscrupulous people are ready to criticize the fundamental integrity of business enterprises. This criticism has been particularly evident during the lean years of the past depression. He indicated that integrity of purpose is very important in the welded fabrication of machinery and equipment. Particularly is this true in Mr. Budd's plant, which aims to carry on the tradition of true craftsmanship. Materials and methods must be absolutely right or else they will not be considered. There is a constant striving for improvement in technique.

Steel Mills Inaugurate Intensive Training School

A school for steel workers, believed to be the first of its kind ever conducted, has just been inaugurated at Pittsburgh by the United States Steel Corporation subsidiary, Carnegie-Illinois. The purpose of the school is to fit workers for better jobs and bigger pay, and as many of the leading industrialists in Pittsburgh rose to the top by starting at the bottom, it is believed that the new undertaking will have a special appeal to those who have the determination to get ahead.

The new school was planned to provide a smooth flow of competent man power up through the organization, according to Ross L. Leffler, manager of industrial relations. Eight plants of the Pittsburgh-Youngstown district are forming classroom training for workers in all the trades and shops of steel making. Some 200 workers are attending classes three afternoons a week. At other times they are employed at their various jobs.

In fabricating welded pressure vessels

What About Preheating?

Shop procedures are detailed for various types of carbon steels

By ORVILLE T. BARNETT

Metallurgist, Black Sivalls & Bryson, Inc. Oklahoma City, Okla.

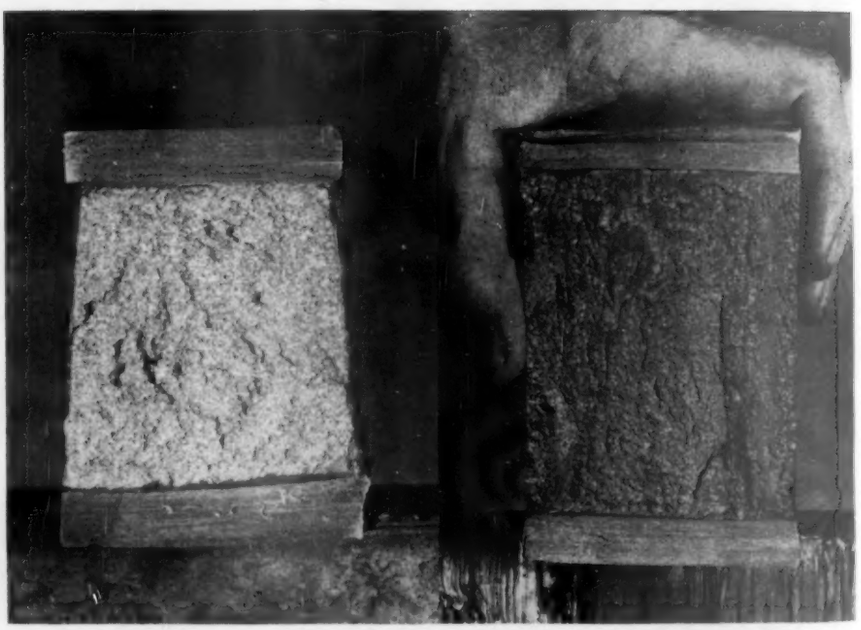

Fig. 1—Contrast between a fine-grained and coarse-grained weld in 2¾-in. steel plate

For a long time the subject of preheating mild steel plates prior to welding has been the cause of innumerable controversies among those interested in the welding of pressure vessels. In particular, some manufacturers have been interested in the subject of preheating as it influences the normalizing effect of multi-bead welding. An attempt is made in this article to shed some light upon this subject in the hope that by bringing the problem out into the open it will encourage the best welding minds to express their thoughts for publication.

The particular problem of the preheating of mild steel plate was forcibly brought to the attention of the writer as a result of a suggestion made by a petroleum company inspector concerning the appearance of alternate bands of fine and course grain in nick-break specimens which he thought could be eliminated through the medium of preheating the plates. Following this recommendation some experiments were carried on with a preheat of 400 deg. F. on flange and firebox quality plates 1½ in. thick. Some slight improvement in the direction of consistently fine grained nick-break specimens was noted.

The object of fine grain is well known. When fracture occurs in a metallic crystalline substance, it takes place along the cleavage planes of the crystals. In a coarse grained weld, for example, which contains few large grains a break may occur across the cleavage grains of the large crystals with but few interruptions or direction changes. In a fine grained weld the many interruptions and direction changes tend to discourage further breaking. The following table[a] illustrates the effect of grain size on elastic limit and maximum stress of commercially pure iron:

TABLE 1

No. of Grains Per Lineal Inch	Elastic Limit Tons per sq. in.	Maximum Tons per sq. in.
70	4.0	21.0
170	5.0	22.0

From this table it may be seen that the elastic limit is materially benefitted by fine grain structure while

[a] Course Outline in Metallography for Welders by W. C. Cumming, State Department of Vocational Education, Lincoln, Neb., 1935.

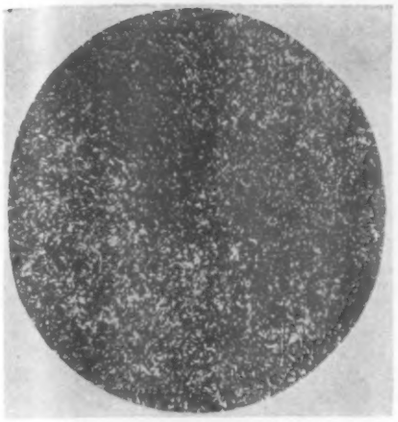

Fig. 2—Fine grain structure obtained by peening and normalizing action (magnified 100 X)

the maximum stress is benefitted to a much lesser degree. In this study much stress is laid upon fine grain structure as the major physical result of preheating, but the ease of welding is also understood to be important without particular emphasis being placed upon this point. In Fig. 1 a fine grained weld in 2¾ in. plate is contrasted with a coarse grained weld.

At the National Metal Congress in Cleveland the writer attempted to get further information on the subject of preheating as it affects fine grain. The thought was voiced by Mr. Deppeler of Metal and Thermit Corp. that fine grain was a matter of using about 16 passes to the inch. Thus work was done along the line of preheating and increasing the number of passes with another slight gain in fine grain structure and ductility.

Further credence was given to the statements of Mr. Deppeler in a timely talk by Mr. Aborn of the United States Steel Corp.[b] in which he stated: "As the liquid cools, crystallization begins at the coolest point, i.e., at the solid-liquid interface possibly also at the air-liquid interface. The first crystals which form are the delta iron type with a carbon content less than about 0.6 per cent and of the gamma iron type when the carbon content is in excess of that stage. These crystals tend to grow normal to the interface mentioned, which means the development of columnar or dendritic shape as they grow inward into the cooling liquid.

"Welding conditions which superheat the liquid and produce a steep temperature gradient tend to aggravate columnar crystallization, while a practice which develops minimum liquid temperature, and increased numbers of crystal nuclei centers in a milder thermal gradient such as is attained by preheating the parent metal tends to minimize columnar crystallization and promote the formation of the so-called equi-axed type of crystals."

Moreover, in combining the additional passes with preheating, the columnar type of crystallization was minimized but was not eliminated entirely. However, the simple addition of judicious peening brought about the fine grained nick-break samples that were sought. One of these is shown in Fig. 1. Fine grain as a result of peening and normalizing action is shown in Fig. 2 (magnified 100x). Figure 3 shows the columnar dendritic structure mentioned by Davenport and Aborn magnified 100x. Figure 4 is the parent plate x 100 for comparison. All three are from a weld in a 2¾ in. plate. It is well to note at this point that these problems apply in the main to plates above 1¼ in. thick where the quenching action of the heavier plate produces the steep thermal gradient mentioned by Mr. Aborn. The thinner beads, too, permit a better transfer of the heat to proper depths assuring a good normalizing action.

Mr. Ronay[c] of the U. S. Naval Engineering Experiment Base at Baltimore mentions an interpass temperature of 200 deg. F. to 300 deg. F. as approaching the ideal for manual welding operations. He states, further, "Starting of each electrode is easier, hence the occurrence of cold shuts and slag trappings is held to the minimum or is

[b] Metallurgical Aspects of the Welding of Steel by E. S. Davenport and R. H. Aborn. The American Welding Society Journal, October, 1936.

[c] "Thermal Influences—How They Affect the Weld Metal" by Bela Ronay, Senior Welding Engineer, U. S. Naval Engineering Experiment Base, Baltimore, The Welding Engineer, July, 1937.

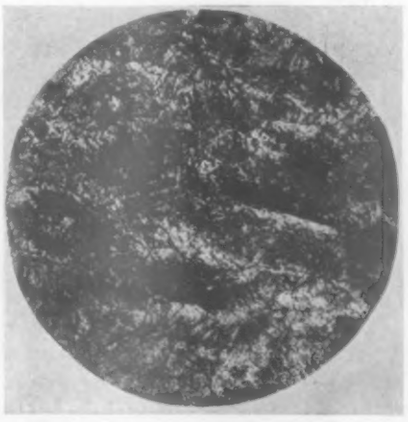

Fig. 3—Columnar dendritic structure (magnified 100 X)

Fig. 4—Structure of parent plate for comparison (magnified 100 X)

entirely eliminated." Further in this same article he suggests the following: "The hotter the interpass temperature up to 400 deg. F. to 500 deg. F.—the greater is the certainty of production of sound metal of maximum toughness and endurance, and, in short, of the best quality from all considerations, including that of stress distribution." Needless to say temperature of preheat may be used interchangeably with interpass temperature.

Not only are we concerned with the relationship of preheating and interpass temperature to the weld itself, but also with the effect upon the fusion zone. Although the work done by Dr. Theisinger[d] was to show the relationship of heat input to the fusion zone in carbon steel of varying carbon content, by a slight stretch of the imagination this work may be correlated with preheat as influenced by carbon content. The dividing line of carbon content in Dr. Theisinger's work was in the neighborhood of .20 per cent carbon. From our observations .25 per cent carbon is the dividing line for the preheating of mild steel plate with the welding heats and speeds that are normal in x-rayed and stress-relieved seam welding.

Dr. Theisinger derived the following formula to establish a unit which he calls joules per inch that may be used in connection with a study of the necessity for preheating:

$$\frac{\text{Amperes x volts x 60}}{\text{Welding speed in./min.}} = \text{Joules/in.}$$

In determining the minimum number of joules per inch that were necessary with a particular carbon content the author of this formula used an increase of 100 points Vic-

[d] "Heat Effect in Welding" by Dr. W. G. Theisinger. Iron Age, October 15, 1936.

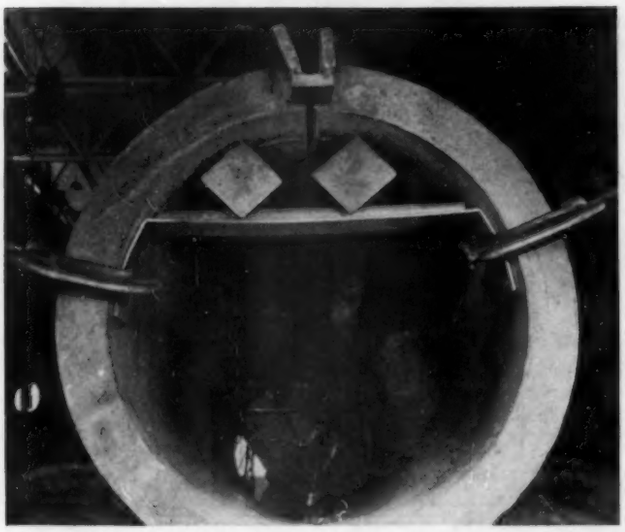

Fig. 5—Preheating units located inside of vessel to be welded

kers-Brinnell hardness as the maximum increase without harmful effects. That is, a heat input that was sufficiently great to increase the hardness of the heat affected zone less than 100 points Vickers-Brinnell was sufficient. The buffer action of a preheated plate where the carbon content exceeds .25 per cent may well be appreciated.

A rather unified opinion exists among the welding engineers the writer has consulted as to the fact that ordinary mild steel plate requires no preheating. Both G. L. Willins of the Champion Rivet Co. and J. H. Deppeler of the Metal and Thermit Corp. have expressed this opinion. Mr. Ronay has suggested that the preheating of mild carbon steel plates is unnecessary. In addition Leon C. Bibber* states, "Generally speaking, mild steels or low alloy steels of the usual structural thickness do not need preheating, but each individual case must be considered separately."

Now from actual production studies it may be stated that preheating is necessary in all plates 1¼ in. and above that thickness for at least the first pass, with 400 deg. F. being suggested as the proper preheating temperature. Figure 5 shows a vessel with heating units in place. The purpose of this preheat is to guarantee sound metal free of both gas and slag from the very root of the groove on up. This preheat in thicker plates allows perfect fusion and ease of welding, because the quenching action of the large mass of metal has been decidedly lowered. Good welding operators are in agreement with this idea. From this point on, the incident heat of welding will suffice, in the majority of cases, and heating may be stopped.

When, however, the carbon content of plates in this thickness range exceeds .25 per cent continuous heating during the entire course of welding is recommended. Heating these plates to 400 deg. F. will minimize the danger not only of cracks, but also of hard heat-affected zones.

The question of preheating of plates prior to welding has some geographic considerations. Where shops are not heated and the temperature inside them drops below 60 deg. F. a preheat to 200 deg. F is in order. Mr. Willins, who was quoted previously, stated that his studies of this problem point to the necessity of a preheat to a minimum of 200 deg. F. Various oil company inspectors report this practice as becoming more universal every year.

The subject of alloy steels falls into a more specialized type of preheating problem. In the consideration of these steels the temperatures to which it is necessary to preheat are quite well worked out from a sound metallurgical standpoint. As a general rule the lighter gauges require no preheating, whereas the heavier gauges require very definite heat treatment.

As far as the non-ferrous metals are concerned, it appears necessary to treat them in the same manner as the alloy steels. Here, again, the lighter gauges require no preheat and the heavier gauges require special attention.

To summarize, the following practices have shown to possess merit:

1. Plates of 1¼ in. and greater thickness should be preheated to 400 deg. F. for at least the first pass.
2. Plates of 1¼ in. and greater thickness with a carbon content in excess of .25 per cent should be continuously heated to 400 deg. F. throughout the welding period.
3. All plates should be preheated to at least 200 deg. F. when shop temperatures fall below 60 deg. F.
4. Alloy steels require special heating attention with the exception of the lighter gauges.
5. Non-ferrous metals follow the same general rule as the alloy steels.

* "Welding Instructions and Standards," Carnegie-Illinois Steel Corp., by Leon C. Bibber, Welding Engineer.

Welded Steel Hopper Barges for Pittsburgh Coal Company

Ten of these welded steel hopper barges were built for the Pittsburgh Coal Company by the Treadwell Construction Company, Midland, Pa. The barges are 175 ft. long, 26 ft. wide and 11 ft. deep. Weighing 150 tons, each barge has a capacity of 1,000 tons. Westinghouse electric welders were used for the 12,000 lineal feet of welding in each barge.

Fig. 1—Assembly fixture for welded rings

Prominent fabricator reviews work in

Welding Large Structures

Improvements in design or production methods carried out without delay because no patterns or castings need be scrapped

By C. C. BRINTON*

Assistant Manager, Generator Division, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TODAY with our greatly increased production many advantages of the fabrication of machine parts from rolled steel, flame cut to the required shape and welded together, to form any desired shape becomes more apparent. Without attempting to arrive at an exact comparison of the investment involved in the equipment required to produce parts of castings instead of fabricated rolled steel, it can be readily seen that flame cutting and welding machines are much cheaper than furnaces and moulding equipment. Also, just as important, the time required for the expansion of production facilities is considerably less.

When production is involved, time lost in replacing and repairing castings is as much of a factor as the cost savings to be found in fabricated construction. Where it was not uncommon to lose time due to scrapping or repairing from 5 to 15% of cast parts, this is now unknown if the part is steel fabricated. Using rolled steel we can be assured that the material is free from sand, blowholes and other imperfections and uniform in quality with constant physical properties.

It was necessary when using castings to carry a wide variety in stock representing a considerable inventory investment compared to stocking standard shapes of a limited variety and plates of the required sizes to take care of the demand. The time required to secure special sizes of plates which are only needed for special machine parts is still less than that required to make up patterns. Developments which improve design or manufacturing methods are now carried out without delay as there are no patterns that must be changed or re-made and no castings to be scrapped or used up for we are using a basic material.

Design Problems Encountered

When first changing many of our structures from cast iron or steel to rolled steel plates and shapes welded together to form approximately the same structure, it was extremely difficult not to produce the identical shapes which made up the individual castings. Although the foundry limitations were well-known the manufacturing and economical limitations for fabrication and welding procedure were not generally recognized with the result that some structures were produced that were not economical or practical for the fabrication.

There has been considerable progress since that time in recognizing that the problem is not solved by balancing the cost of steel plate at 2 cents per pound against a rough casting at 6 cents. It is better to

* Presented before a joint meeting of the American Welding Society and American Society of Mechanical Engineers at Hotel Traymore, Tuesday afternoon, October 19, 1937.

Fig. 2—Assembly fixture for twin motor frame

With a reasonable activity, we have been able to establish a standard ratio to use for such material as follows:

Steel plates	160%
Steel slabs	110%
Angles, bearings, channels, etc.	110%

The results of the application of these ratios are shown for a typical month of 1937 in Table 1.

Choosing Stock Sizes

In order to keep the amount of scrap within or less than the ratio, it is necessary to choose the stock sizes to suit those of the largest activity that are needed for the particular parts used, and to order special sizes for large parts or those that require a large amount for a particular order of a size not carried in stock. Unfortunately, there are not enough small pieces required for our type of fabricated structure to allow the greater part of the scrap to be used and it requires close supervision to apply unused portions of plates to this activity economically.

The supervision is most important at the time the drawings are made since the scrap ratio is generally determined by the design of the parts and the choice of plate sizes from which parts are cut. Also, it is possible in some cases to apply some of the scrap pieces to other parts of the structure if a careful layout is

think of cast iron ready to pour and steel plates and shapes ready to be flame cut and formed to shape, as the raw material in each case and build up from there the final cost of each type of structure to be manufactured.

Table 1—Scrap Ratios Based on Typical Month

	Amt. Rec'd. (lbs.)	Consumed (lbs.)	Scrap (lbs.)	Ratio
Plate	1,565,000	1,002,000	563,000	156%
Slabs & Bars	356,022	317,572	38,450	112%
Shapes	236,489	226,509	9,980	104%
Total	2,157,511	1,546,081	561,330	140%

Low Scrap Ratio

The available shapes produced by the steel mills are basically structural and were designed for building bridges, buildings, etc., but with careful selection of those suitable for machine parts and their application in the proper place in the part, many economical structures are now produced with a low scrap ratio. Plates, however, are made commercially in a wide variety of sizes and thicknesses which can be cut and shaped to most any desired form to serve any application and used with the standard shapes when desirable in fabricating nearly all machine parts. The only limitation so far has been the size of the plates produced on the largest plate mills.

For some heavy sections it is desirable to use semi-finished material such as slabs, billets or blooms, although these are primarily intended for re-rolling and consequently the tolerances are larger than on finished materials, they are suitable for parts that must be machined or where the larger tolerances are no handicap.

For certain parts of these structures it is economical, in many cases, to use steel castings welded to the structure when the sections are of such shape that it is difficult economically to make the entire part of plates and shapes. Although no definite rule can be established to cover such cases an example of the use of castings is for heavy cylinders as bushings in large gear cases.

The problem of arriving at the cost of any structure is not always clear cut, unless there is a definite application of the scrap pieces left when the parts are cut, or the structure be charged with the rough size plates and shapes and only credited with the scrap value of left-overs.

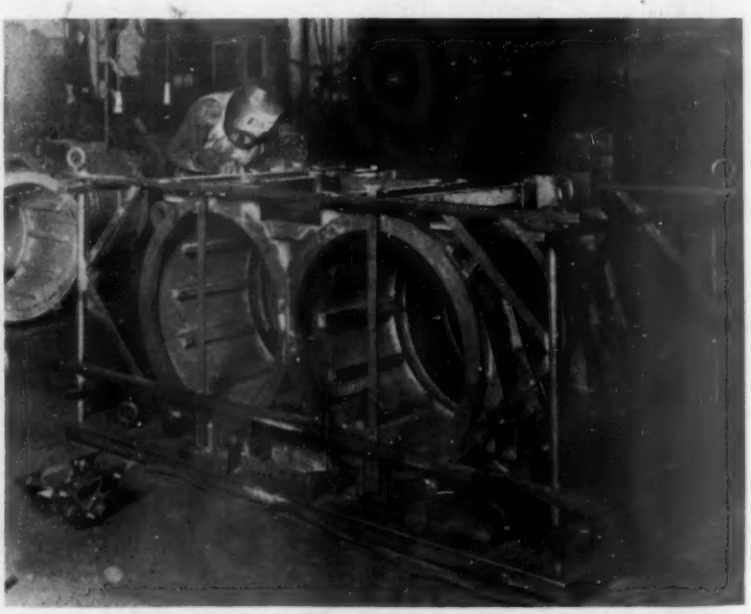

Fig. 3—Assembly fixture for twin motor frame

Fig. 4—Inspection of frame after welding and stress relieving

Fig. 5—Frame section mounted on automatic welding machine

made of the cut out pieces. The burden of carrying a great many irregular shaped pieces for an indefinite time in the manufacturing development for possible application is generally too great and these pieces must be scrapped at regular intervals or will be used up inefficiently.

The problem of assembling parts together in the minimum time and with sufficient accuracy that excessive weld material will not be needed, can only be solved by cutting and forming the pieces to exact size and shape with weld preparation carefully done. Pieces that leave large gaps between parts or require extra cutting by hand during assembly cause more lost time and extra welding than any other condition met in fabrication.

In order to avoid this condition, careful layout before cutting, using sheet steel templates where enough pieces of the same shapes are required, is done for parts too large

Fig. 6—Welding operation on center section of large upper bracket for waterwheel generator

Fig. 7—Rotating and tilting fixture for frame section

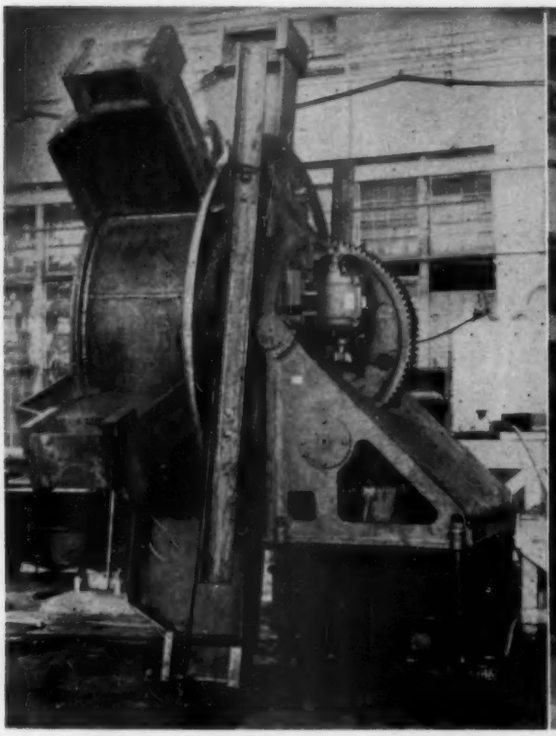

Fig. 8—Lower thrust bearing bracket for waterwheel generator mounted on manipulator

Fig. 9—Positioning heavy press bed with overhead cranes

for automatic cutting machines. The layouts are prick-punched at a few places so that the cutting may be checked easily as the cutting progresses. In many cases it is possible to cut the part out of the large plates without cutting through the outside boundaries and avoid some of the distortion from the cutting torches. For the smaller pieces the cutting machines using paper templates or steel where the magnetic method is used, will produce very satisfactory parts and in many cases several parts of the same shape are produced at the same time with two or more cutting torches.

Specializing of Work

In order to arrange the work most economically the cutting, grinding and trimming has been grouped so that all this activity is segregated from the assembly and divided into certain classes so that a group always does the same class of work. In like manner the assembly before welding is divided into several classes so that each group handles only one class of work.

When assembling and tacking the large parts for final welding, steel surface plates are used that are sufficiently accurate to keep the structure level and allow the parts to be aligned properly. Enough tack welding is applied to hold the structure in shape and in most cases, to move it to another location for final welding. The welding procedure is not the same with all structures, but varies to suit the problem and usually is arrived at from experience with similar parts with a certain amount of cut and try and checking during the actual welding.

Since one of the main elements in cost savings is in reducing the time required for machining and eliminating some of the machining operations, it is necessary to use fixtures for holding parts in place while assembling and welding and to avoid distortions by the proper welding procedure.

A typical example of the use of a simple fixture is shown in Fig. 1 where rings are welded together and held to a definite size; Fig. 2—setting motor frames in a locating fixture that is designed to hold the parts in alignment and shorten the assembly time and Fig. 3—tack welding the parts of the twin frame after they have been accurately located in the complete fixture; Fig. 4—checking the completed structure after the final welding and annealing.

Design Influences Shop Cost

When practical it is desirable to design parts so that most of the welding may be done in the automatic machine and advantage taken of the lower costs and more reliable welding. The motor frame in Fig. 5 is an example where this can easily be done. It is more difficult to follow the same procedure for such parts as shown in Fig. 6 where the size is such that the welder must work on a platform. In this case the manipulator which handles the work has the controls mounted on the same panel with the welding machine controls and within easy reach of the operator so that the part and the welding machine can be operated from any position that the operator takes.

Positioning Equipment

Many welding operations cannot be made with the automatic equipment and it is often desirable to provide handling fixtures to aid the operators to position the pieces for down-hand welding with a minimum of effort such as that shown in Fig. 7. Fig. 8 shows a large supporting bracket for a vertical generator that would be an awkward piece to handle for down-hand welding without equipment to position it readily.

The mounting of large parts so they may be handled safely and mounted quickly is the main problem to solve for the successful use of such equipment, as they are adaptable for both automatic and hand welding and the positioning can be controlled from any desired station within reach of the operator. Many pieces that are of such size and shape that it is impractical to provide equipment to position them are moved with a crane from one position to another, or held in place

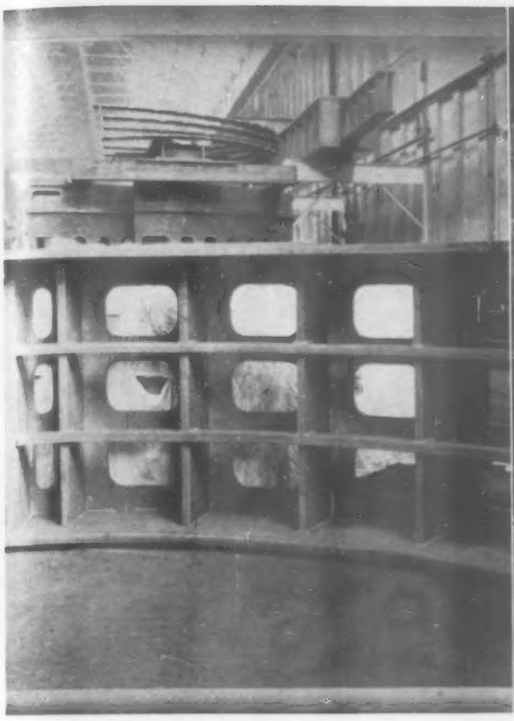

Fig. 10—View from inside of vertical generator frame

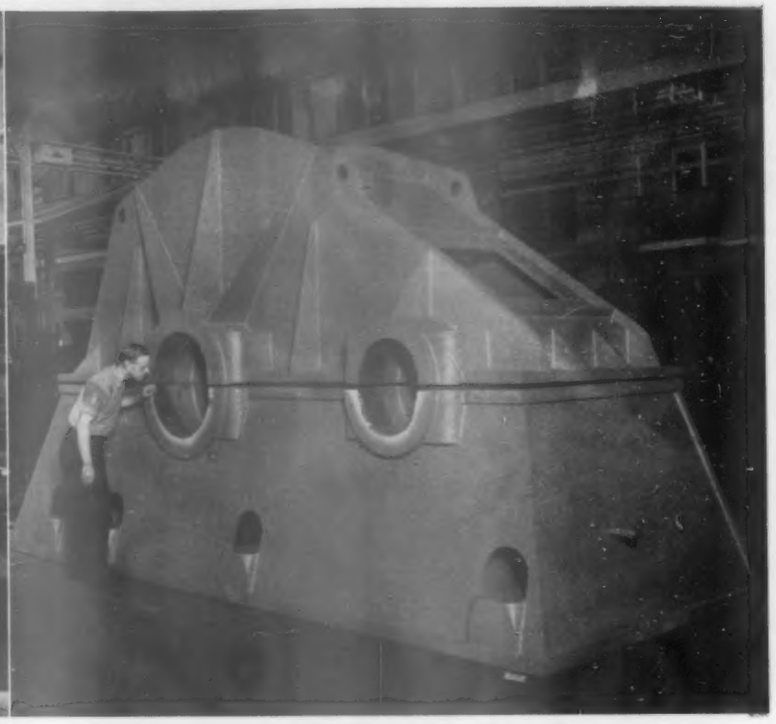

Fig. 11—Welded reduction gear housing

while welding as illustrated in Fig. 9.

Fig. 10 shows one section of the frame of a vertical generator illustrating the progress made in reducing the number of pieces required to construct a suitable frame. The amount of weld metal to be deposited usually varies directly with the number of pieces welded together, therefore this has influenced the design of machine parts to a greater extent than the placing of parts to facilitate welding and assembly.

Where weight limitations will allow, it is usually found more economical to use plates of sufficient size so that they do not require supports or braces for stiffness. In some cases it is cheaper to do forming of the lighter plates to provide stiffening sections rather than weld on extra pieces for that purpose.

Fig. 11 shows a gear housing where steel castings and heavy plates have

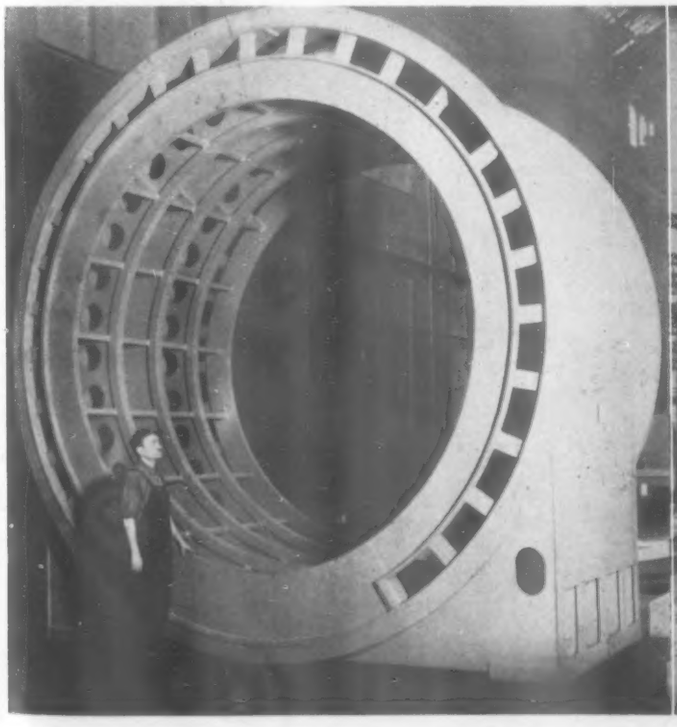

Fig. 12—Frame for part of hydrogen cooled frequency-changer

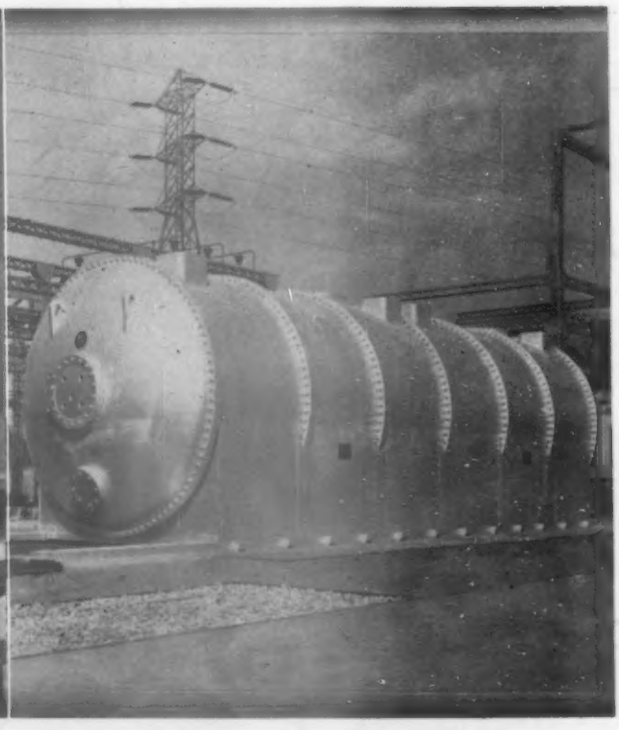

Fig. 13—Frequency-changer installed outdoors

Fig. 14—Turbine driven generator frame

Fig. 15—Rotor for D-C armature

been used with a limited amount of bracing, but it is possible that further improvements can be made with a better understanding of all the economical problems involved. All structures, however, reflect in the design the type of tool equipment available in the manufacturing section.

The improvement in welding rods and the technique of application has made possible the easy production of large frame structures for the use of hydrogen gas as a cooling medium for generators, synchronous condensers and frequency-changer sets. These machines must not only be practically leakproof with hydrogen, but explosion proof if a favorable mixture of air and hydrogen should be present at any time.

By the use of double welds at the important points where they may be checked for leaks by introducing air pressure between welds, leaks are repaired as each weld is completed so that when the final structure is ready, only a few repairs are necessary. The final test requires that the completed frame will withstand a standard hydrostatic test for boilers and a time leakage test with hydrogen. Fig. 12 shows the generator frame for the 60,000 kw. machine of a frequency-changer set and Fig. 13 the completed set installed. Fig. 14 is the frame of a hydrogen cooled turbo generator showing the use of a ventilation passage construction as stiffeners for the frame structure, and an unusual eccentric location of the stator laminations to allow the water coolers to be placed at right angles to the axis and above the frame center.

Fig. 16—Rotor for A-C generator

Large Welded Armatures

Fig. 15 illustrates the adaptability of a welded construction for large d-c. armatures where the heavy arms are used for providing ventilation acting as blowers in forcing the air through the ventilating ducts in the laminations as well as mechanical supports for the structure. The steel ring end plates are shrunk on and doweled to the arms to provide a means for holding the laminations and taking the torque.

A number of rotor spiders have been made that are highly stressed in the rim section by rolling concentric rings welding them completely through at the ends, machining the two rings and the hub assembly so that the rim is pre-stressed the required amount to avoid stresses in the welds on the arms. The rim welds are placed 180 deg. apart in the assembled spider shown in Fig. 16.

Although much progress has been made in constructing economical machine parts by welding, many more savings can be made in the development of better assembly and handling methods and the design of simpler structures, than in the actual application of the weld metal. However, we are still making satisfactory progress in the art of developing welding rods that produce more satisfactory welds at greater speeds.

The Story of Acetylene

By W. F. KUHL*

District Manager, Shawinigan Products Corp., New York

(CONCLUDING INSTALLMENT)

Acetylene Generator

The generator, containing water and equipped with a hopper to hold the carbide, is operated automatically and the rate at which gas is generated is controlled by the gas pressure itself.

The owner or operator of the plant has only to fill the tank to the required level with water, put the carbide in the hopper and start the feeding mechanism. When the gas from the carbide is entirely consumed, the water with its lime content is pumped out; the tank refilled with fresh water, the hopper re-charged with carbide and his utility plant is again in operation. If the gas jets are kept clean, the flame will be quite steady.

Nearest Approach to Sunlight

The luminosity of acetylene burned under the same conditions, is far superior to other gases. It produces a brilliant white flame containing, in proportion, all the spectrum colors possessed by sunlight itself. Scientists have determined it to be the nearest approach to sunlight discovered up to this time. To further their contention they have made some experiments with plant life. Flowers, for example, have been grown in dark rooms by exposing them only to acetylene lights instead of the sun's rays. Strawberries exposed to sunlight by day and acetylene light by night required only three-fourths of the time needed by plants grown under the sun alone, and the fruit ripened some two weeks in advance of that not so treated. Radishes also required but three-quarters of the usual time, and peas, beans and lettuce plants showed marked acceleration in growth. Many of our farmers have profited too through its use in the hen houses. Chickens are provided with more artificial sunlight hours and this means of increasing their active periods results in greater egg production.

True Color Matching

The quality of the acetylene light is of such high proportions that colors displayed under it appear at their true values. Other lights which do not possess the same qualities of whiteness, tend to distort and in some cases completely change colors. Under the acetylene flame, however, even the color shades can be matched.

In addition to the luminous efficiency, acetylene light has another advantage for home lighting in that it does not vitiate or foul the air, nor consume the oxygen in the room to the same degree as is the case with other gas flames. Acetylene or carbide gas as it is sometimes called, is also very satisfactory for cooking —it is normally cheaper than electricity and because of its higher heat values is much faster in performance, and with the proper air mixtures is entirely free from soot.

Household Appliances

Such modern conveniences as the hot-plate, the cook stove, the cabinet range with its bake oven, the bread toaster, the coffee percolator, the flat iron, the parlor and bedroom heater, the hot water heater, the refrigerator and many others, have been placed at milady's service and pleasure through the discovery of calcium carbide and its offspring—acetylene gas. Nor need she suffer from an inferior artistic or aesthetical sense, as the present day acetylene utensils are a tribute to the craftsman's skill and artistry.

As is usually the case when man suddenly gains increased liberty or freedom over previous established standards, he is prone to indulge in excesses. The Creator gave us a set of eyes which were intended for use approximately half of the twenty-four hour cycle—or from dawn to dusk. With the advent of highly developed artificial lighting, this too was changed. Our daily habits and conditions under which we employ our sight, result in eye strain and faulty vision. We overcome this, in part at least, by striving to provide clean, well ventilated work shops and rooms accessible to plenty of sunlight. Where artificial light is necessary in the absence of the sun, and especially at night, acetylene gas lighting helps to relieve the strain through its soft sunlight qualities.

The Creative forces first provided us with sunlight as an efficient light source. Man being what he is, one of the most complicated of all nature's achievements; was in the beginning exceedingly slow, viewed by present day standards, in acquiring the intelligence and deftness which eventually drew secrets from their hiding places.

Importance of Artificial Light

Slowly but surely he forged steadily onward; the pace accelerating and the importance of his accomplishments keeping step. His work in the development of artificial lighting has the aspect of being the most valuable of all his accomplishments. In the present day scheme of things, the gas and electric light are the most outstanding, and acetylene gas occupies a unique position of importance in relation to the light-producing elements which have so greatly advanced our lighting structures across the the ages from the first burning stick or fagot. And we can truly say, acetylene gas from calcium carbide may be called the "Little Brother of the Sun."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS announces the election of H. N. Davis, president of Stevens Institute of Technology, Hoboken, N. J., as president of the Society for 1938. Mr. Davis will assume office on December 10, 1937. The following have been elected as vice-presidents for 1938: F. O. Hoagland, Hartford, Conn.; B. M. Brigman, Louisville, Ky.; Harte Cooke, Auburn, New York; W. H. McBryde, San Francisco, Calif.; and L. W. Wallace, Chicago, Ill. The following have been elected managers for 1938: Carl L. Bausch, Rochester, N. Y.; S. B. Earle, Clemson College, S. C., and F. H. Prouty, Denver, Colo.

*We published the first part of Mr. Kuhl's article in our October, 1937 issue, pages 48 to 50 inclusive.

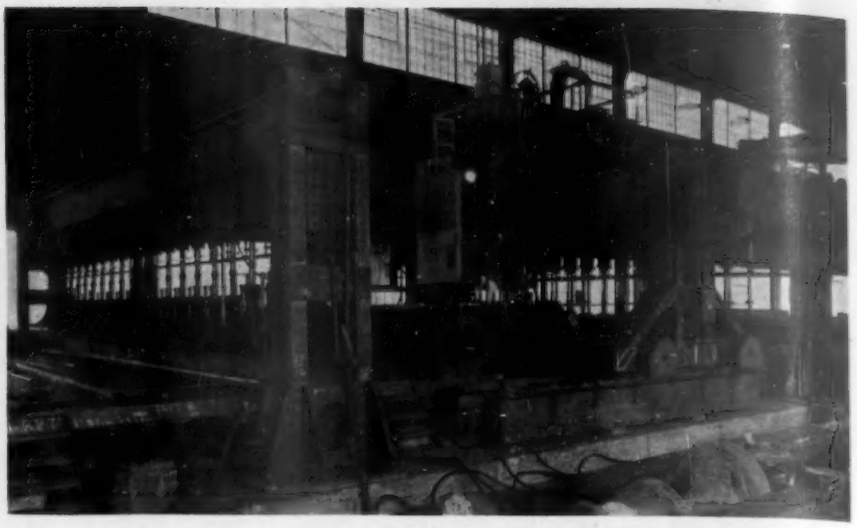

Fig. 1—Automatic welding machine layout: (Left) Tacking table, (Center) Tilting table, (Right) Butt-welding machine

Paper awarded Lincoln Gold Medal:

Welding in Tanker Construction

Substantial savings in weight and lessened corrosion—New electric process solves distortion shrinkage, and stress problems

By T. M. JACKSON*

Electrical and Welding Engineer, Sun Shipbuilding & Dry Dock Co., Chester, Pa.

This technical paper was awarded the Lincoln Gold Medal by the Award Committee of the American Welding Society at the annual meeting, October 18th. Membership of the Award Committee—Colonel G. F. Jenks, chairman; F. E. Rogers and K. V. King.

—The Editor

FOR several years welding engineers have been engaged in research work which has advanced welding in ship-building to the point where it is now recognized by both ship-builders and ship owners, not with suspicion but a natural development, as a means of saving weight, and of securing greater simplification and economy in ship construction. By the elimination of indirect connections, rivet heads, etc., the welded structure provides smooth surfaces which permit good drainage and easy cleaning and are subject to less surface corrosion. The advantages and possibilities are practically limitless and at present it is hardly possible to say how far they will lead in modifying present structural design. There is a natural tendency to modify it only to the extent that present welding technique and knowledge permit.

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First Welded Vessel

The first self-propelled vessel to be electrically welded was the "Fullagar," which was built in England in 1920 and which to the author's belief, is still afloat and doing excellent work. While this vessel proved that welding could take the place of riveting, no saving in weight was accomplished as the vessel was originally designed as a riveted structure. One of the first all-welded self-propelled tankers built in this country was the "White Flash," a vessel 201 ft. x 2 in. long overall, 34 ft. beam and 12 ft. molded depth built by the Sun Shipbuilding & Dry Dock Co. for the Atlantic Refining Co. in 1930.

This was followed three years later by a duplicate ship, the "Franklin," for the same owners. Both vessels have surpassed expectations and proved that welding could, with confidence, be substituted for riveting. A bold initiative, both by the owners and builders, was taken in February, 1936, when the Atlantic Refining Co. placed with Sun Shipbuilding & Dry Dock Co. an order for a tanker 542 ft. 5 in., long overall, 70 ft. beam and 40 ft. depth of 18,500 D.W.T. in which the entire cargo tank space extending from the engine room bulkhead to the forward end of tank space, a length of 353 ft. was to be 100% welded construction. In March, 1937, the same owners placed a repeat order followed by an additional contract for a similar vessel for the Sun Oil Co., making at the present time three tankers, each over 18,000 D.W.T. with tank spaces completely welded.

In addition, the same builders now have under construction six other tankers of 12,900 D.W.T. which will have all interior construction of cargo spaces, including longitudinal

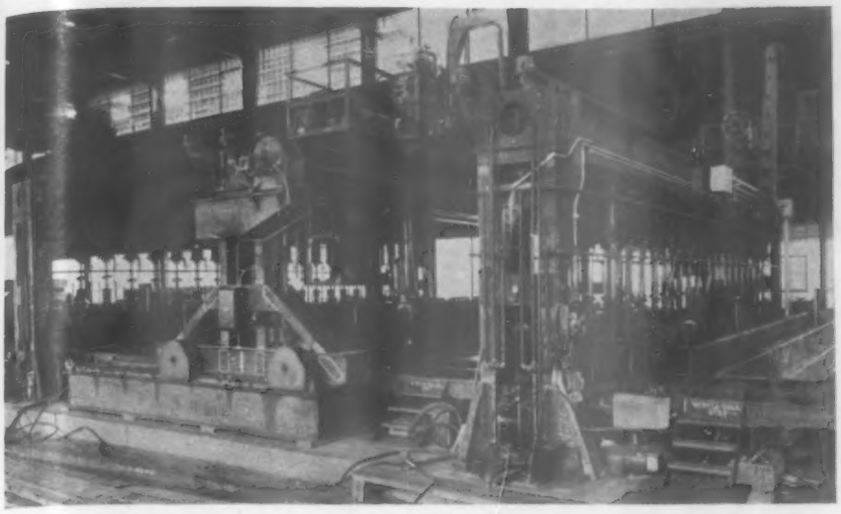


Fig. 2 — Automatic welding machines in Sun shop. Butt-welding machine shown clearly at right

and transverse bulkheads, etc., welded. The shells of these six vessels will be riveted. The nine vessels mentioned will all have miscellaneous fittings; structures such as masts, rudders, foundations, storage tanks for oil and water, cargo piping, etc., of welded construction. Vessels having steam propulsion will have welded boiler drums, condenser shells, etc. Diesel engine driven vessels will have engine foundation, bedplate, main structure of engine and high pressure air storage tanks all welded. To date, rules of the Department of Commerce, Bureau of Marine Inspection and Navigation, will not permit the welding of high-pressure steam piping. A committee of the American Welding Society has been working for some time preparing a code and specification to cover such work. It is hoped this limitation will be removed in the near future.

The nine vessels mentioned represent orders from six companies, each operating a large fleet of tankers. I mention this work in our yard *only* because it presents concrete evidence of the confidence of a rapidly increasing number of owners, of a particular builder, of classification societies, insurance companies and government departments having jurisdiction of welding of not only the hull structure, but also the main propulsion and auxiliary equipment of large ocean-going tankers. It is now recognized that electric welding has become practically indispensable, that it is a sound method of construction to say nothing of the great saving in weight which in the first three vessels mentioned, will amount to about 15% for the hull structure alone.

Members of the American Welding Society will be most interested in the welding processes employed, methods of assembly and sequence of welding used in fabricating and erecting the hull structure of the three large vessels mentioned.

As a welded structure of this size had never before, to our knowledge,

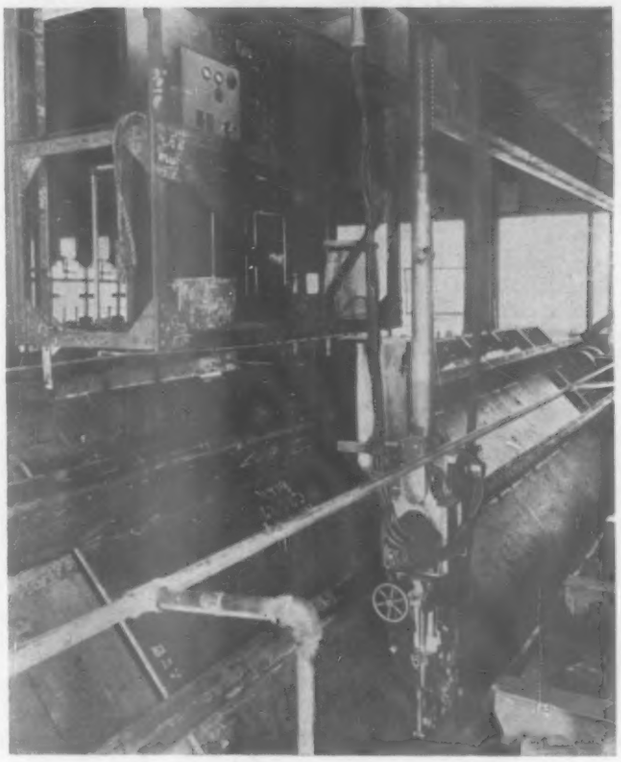


Fig. 3—Close-up view of tilting table with welding head in position for welding

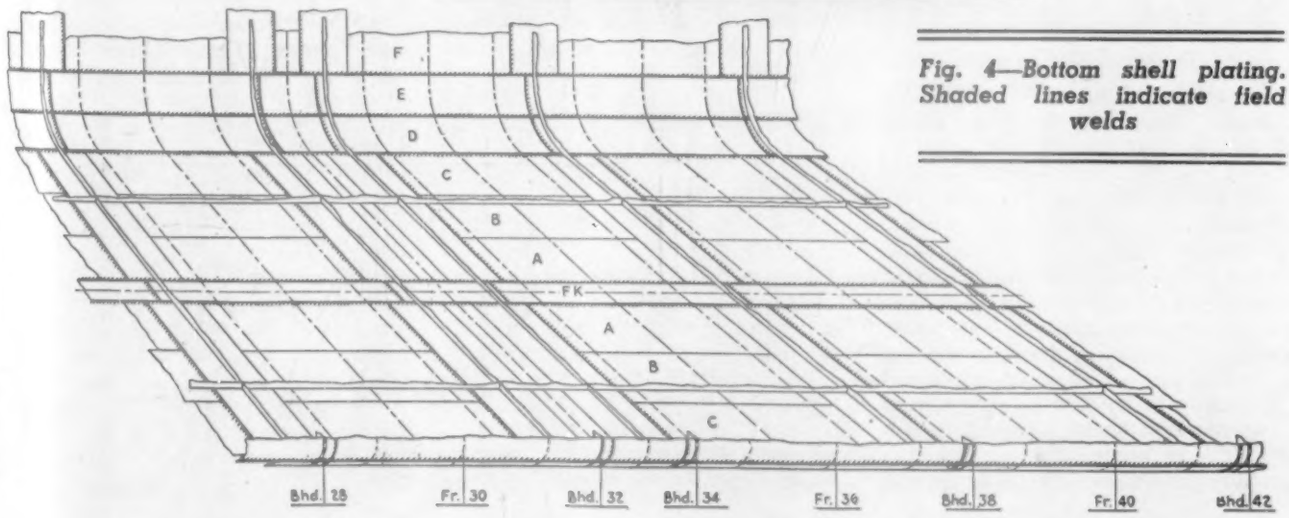


Fig. 4—Bottom shell plating. Shaded lines indicate field welds

Fig. 5—Side shell and upper deck plating

been attempted, the greatest care and study was given to developing the best method of assembling and erecting the various members in the ship. Butt welding was adopted for all the main structure, lap welding being used only for bracket connections and joggled vertical panel plates at the longitudinal bulkheads in way of the transverse bulkheads. A few modifications from usual design were adopted, the principal being the use of heavy wrapper plates at the bulkheads, at the decks, bottom and side shell as illustrated in Figs. 4 and 5. In line with our usual practice, the longitudinal bulkheads are continuous, the transverse bulkheads intercostal, dividing the bulkheads into three pieces, none of which are too large or too heavy to handle in one piece. In welding a ship's hull the most important matters to be kept in mind are their great rigidity, possible loss of dimension due to shrinkage, possible distortion and residual locked-up stress.

As a tanker for the largest part of its length is practically a series of multiple units, that is, similar tanks, automatic machine welding of large shop assemblies insured maximum welding economy and fastest construction. In the past automatic machine welding using bare wire has been used to a very limited extent, but immediately became obsolete with the advent of shielded arc electrodes for manual welding. There seems little prospect of successful application of multiple layer machine welding using a shielded electrode to hull construction. Machine welding means starting at one end of a seam and welding continuously to the other end. Every shipyard welding engineer knows it is impossible to control distortion, shrinkage and residual stress using such an automatic process employing multiple layer deposition.

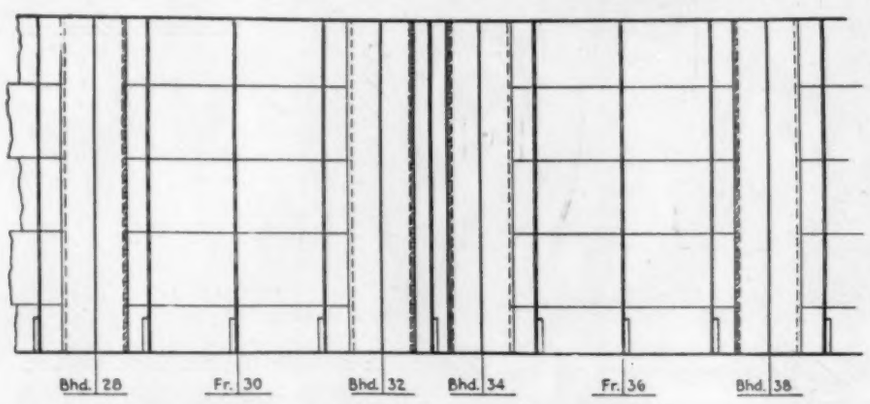


Fig. 6—Longitudinal bulkhead. Shaded lines indicate field welds

Unionmelt Process Used

Very thorough preliminary investigation indicated that the "Unionmelt" automatic process adopted for this work would solve this problem of distortion, shrinkage and stress. Actual experience has fully demonstrated that it does, at least so far as large shop assemblies are concerned. I mention the "Unionmelt" process because we adopted it. Other similar processes may be equally successful.

All the different parts of the structure were shop assembled in one tank length. The center keelson, rider plate and flat keel plate with the

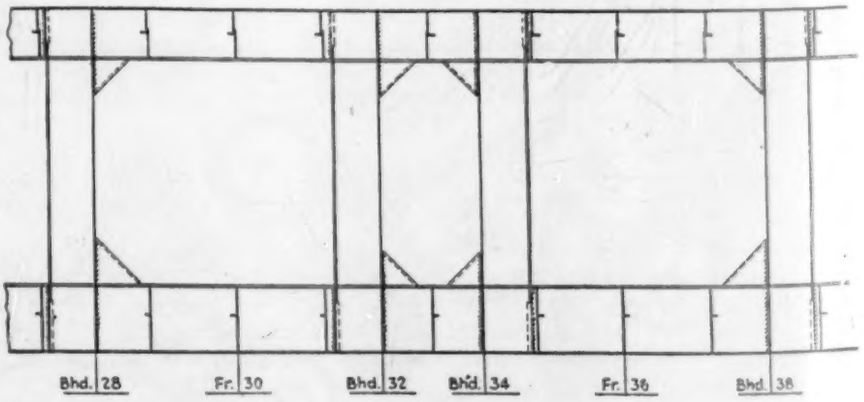


Fig. 7—Vertical keel and center deck girder. Shaded lines indicate field welds

transverse brackets (Fig. 12) was one assembly and manually welded. The center girder at the deck with center deck plate and transverse brackets, Fig. 11, was one assembly also manually welded. The bottom shell from the keel to the lower turn of the bilge together with one wrapper plate, longitudinal stiffeners and transverse web frames, Fig. 4, was one assembly. On this assembly the longitudinals and the shell longitudinal butts were machine welded, the transverses were welded to the shell manually. From the up-turn of the bilge to the sheer strake together with the bulkhead wrapper plate, transverses and longitudinals were one assembly.

As in case of the bottom shell, each plate had three longitudinals and

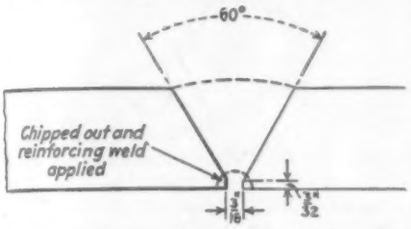


Fig. 8—Plate edge preparation for manual welds

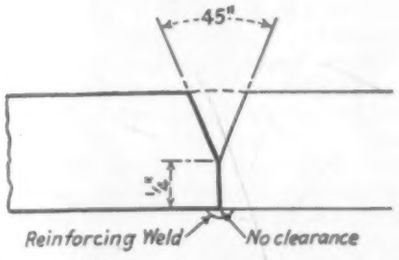


Fig. 9—Plate edge preparation for automatic welds

Fig. 10—Section through forward portion of shell

shell butts machine welded. The deck plating was treated in a similar manner and was in two assemblies on each side, one from the centerline strake to the inboard side of the longitudinal bulkhead, and the other from that point to the side of the ship, as shown in Fig. 5. The transverse bulkheads, as previously stated, were in three pieces, the center position and two wings, intercostal between the longitudinal bulkheads. All horizontal stiffeners and butts were machine welded, the webs, which were assembled with the bulkheads were manually welded.

The longitudinal bulkhead final shop assembly was one tank length. Each plate was treated separately,

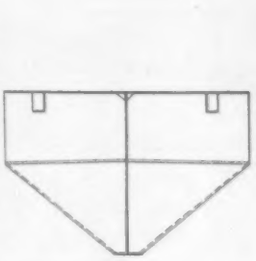


Fig. 11—Center deck girder assembly

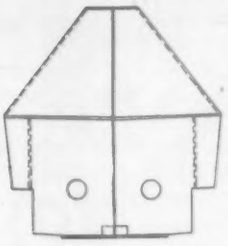


Fig. 12—Vertical keel assembly

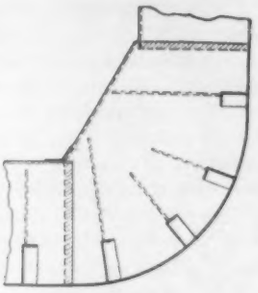


Fig. 13—Transverse frame at bilge

that is, the longitudinals were machine welded to each plate and then the horizontal butts were machine welded. The vertical panel plates were then fitted and welded to the horizontal plates together with the overhanging longitudinals, which were all manual welded. This vertical panel plate, as will be noted, is joggled and overlapped onto the adjacent plates. This is the only overlap in the large assemblies. The reason for this was that this plate was originally intended to be welded to the transverse bulkhead, making it part of the bulkhead assembly; adjacent plates could then be bolted to the overlap in erection. This method, however, was found to be too cumbersome and was abandoned in favor of the assembly shown in Fig. 6 and Fig. 15.

Shop Welding Procedure

In preparing the parts for machine welding, the mill scale was removed from all faying surfaces. The longitudinal stiffeners were then placed in position on tacking table, left Fig. 1, dogged down and tack welded. The plate was then placed on welding tilting table, center Fig. 1, where a continuous fillet machine weld was deposited on each side of each stiffener. Adjacent plates were similarly treated. The plates with stiffeners already welded were rolled along the welding slabs to the butt welding machine, right Figs. 1 and 2. Here they were carefully aligned, dogged down and the butts machine welded in one pass.

Next, they were transferred to the manual welding tables, extreme right Figs. 1 and 2, where the transverse web frames were fitted and welded by manual arc. Finally, the bulkhead wrapper plates were fitted and the vertical butts, together with the ends of longitudinals which overhung the already assembled plating shown in Fig. 10, were hand welded, thus completing one assembled section. Shop assemblies of longitudinal and transverse bulkheads, bottom, deck and side shell were similarly made. Before final erection the opposite sides of all butts were reinforced, either by hand arc or portable automatic welding machine.

Erection of Unit Assemblies

In erecting the assembled units, it was decided to start with a 117-ft. section of the structure consisting of three cargo tanks, each 35 ft. long, and a 12-ft. pump room. The erection was carried out in the following order. The first unit was the shop assembled flat and vertical keel, in one tank space lengths, with frame brackets attached as shown in Figs. 4, 7, 12 and 14. This was followed by the complete bottom shell assemblies, from the flat keel plate to the lower turn of the bilge, port and starboard, in one tank space lengths, see Figs. 4 and 10. In connecting these assemblies to the flat and vertical keel, the bottom transverse frames were bolted to the frame brackets on the keel assembly and the seams of the flat keel and garboard strake were tack welded. Details of construction at the bottom of the webs on both the transverse and longitudinal bulkheads were arranged to permit the entire flat and vertical keel and bottom shell to be placed before any bulkhead was erected.

The complete amidship pump room was next placed in position, the assembly and erection being a modification of that used throughout the tank space. From the amidship pump room the erection was completed one tank space at a time in both directions from amidship.

For each tank space, the center section of one transverse bulkhead was first placed in position. By tack welding the middle bulkhead web to the vertical keel and by bolting the other webs to the bottom longitudinals the bulkhead was temporarily self-supporting. This was followed by

the longitudinal bulkhead assemblies, port and starboard, as shown in Fig. 6, tack welded to the transverse bulkhead and bottom shell and bolted to the previous section of the longitudinal bulkhead. The webs on the longitudinal bulkhead at the frames were bolted to the bottom transverse.

The center deck girder assembly, with the center strake of the deck and the frame brackets attached, as shown in Figs. 5, 7, and 11 were next hung between the transverse bulkheads. This unit was bolted to the middle transverse bulkhead web at one end and tack welded to the bulkhead plating at the other end. After sufficient temporary support was placed under the center girder, the two side center deck assemblies, see Fig. 5, were placed in position. The transverse beams on these sections were bolted to the frame brackets on the center girder and to the frame brackets previously welded to the longitudinal bulkhead.

Fig. 16 — Section of bottom, vertical and two transverse bulkheads assembled on the ways

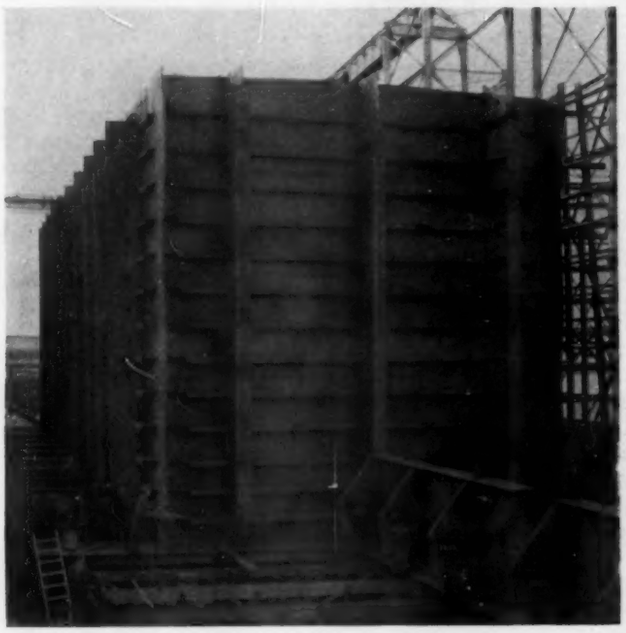


Fig. 14—Erection of 117-ft. section, including three cargo tanks and pump room between twin longitudinal bulkheads

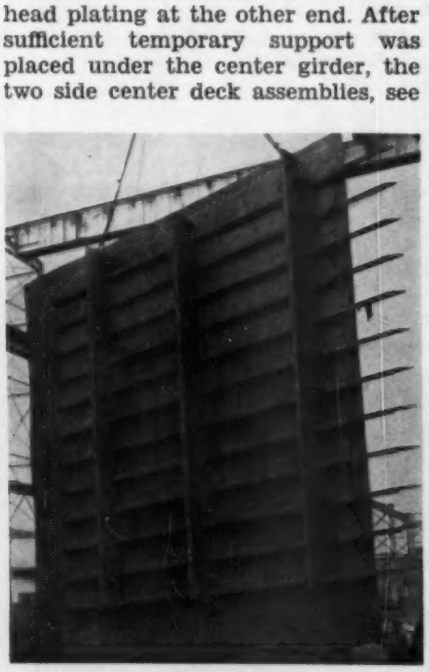


Fig. 15—Typical section of automatically welded longitudinal bulkhead

The two outboard sections of the transverse bulkheads were next erected, the erection of these being similar to that of the center line section of this bulkhead. The bilge plates were not assembled in the shop. These were left until completion of all erection and were the closing plates of the entire unit. After the outboard section of transverse bulkhead was erected, the bilge brackets, see Fig. 13 and Fig. 14, were next put in place and bolted to the transverses erected with the bottom shell. This was followed by the erection of the bilge longitudinals. The side shell plating along with the transverses and one wrapper plate, as shown in Fig. 5, were next erected in position, the lower part of the transverses connected by bolts to the bilge brackets already in place, and tack welded to the wing transverse bulkheads. The outboard deck section shown in Fig. 5, along with the transverses which were bolted to the frame brackets already in place, completed the 117-ft. unit.

As previously stated, the bilge strakes were the closing plates and were lifted from the ship. Before final welding was started, the vessel was well shored, aligned and checked for length, which was found to be exactly 117 ft.

The sequence of final welding the assembled unit was as follows: The flat keel seams throughout, port and starboard simultaneously were first welded, followed by the longitudinal bulkhead connection to the bottom shell. The transverse bulkhead connection to the bottom shell out to the lower turn of the bilge was the next procedure. Following this all transverse butts in the bottom shell plating, including the butt of the flat keel, were welded. Then the overlap of the bottom shell longitudinals on the bottom shell were welded in place. Following this the transverse bulkhead to the longitudinal bulkheads were next welded. The deck plating was next welded, concluding with the welding of the side shell.

Back-Step Method

In the welding of all butts the back-step method was used. In the case of the flat plate keel, for instance, two welders worked on each seam, port and starboard simultaneously, working away from the center toward the ends, back-stepping the welding. By so doing, distortion and shrinkage were reduced to a minimum.

In welding the main units both automatic machine welding and manual arc welding were employed. At present, automatic welding is used only on shop assemblies. The manual arc is used on shop assemblies where

"The Unionmelt process is not an electric-arc process in the usual meaning of that term; resistance fusion more correctly describes it. It is well known that mineral compounds or mixtures will conduct electric current when in the fused or semi-fused condition. In this process the fused melt carries the current with a resistance which corresponds to a voltage of from 25 to 50 volts depending upon the voltage regulation effected by the control mechanism. The release of electrical energy, due to the resistance of the fused melt, provides the heat for making the weld."
—T. M. Jackson

use of the automatic machine is impractical; it is also used on the shipways to weld together the assembled sections.

The automatic Unionmelt process being used has several marked advantages. It speeds up production, greatly minimizes residual stress and distortion, it practically eliminates loss of dimension due to shrinkage, insures uniformity and protects the weld from atmospheric contamination. The effect of this protection is evident in the physical test results. The Unionmelt process is not an electric-arc process in the usual meaning of that term; resistance fusion more correctly describes it. It is well known that mineral compounds or mixtures will conduct electric current when in the fused or semi-fused condition. In this process the fused melt carries the current with a resistance which corresponds to a voltage of from 25 to 50 volts depending upon the voltage regulation effected by the control mechanism. The release of electrical energy, due to the resistance of the fused melt, provides the heat for making the weld.

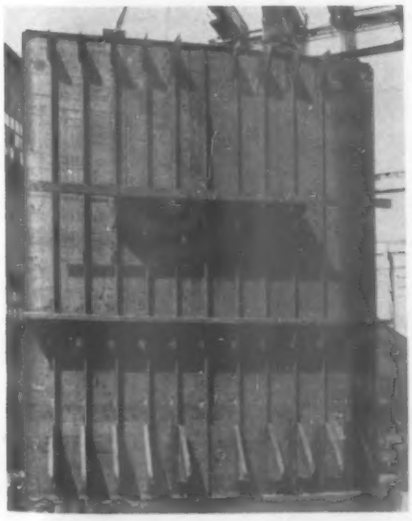


Fig. 17—Typical riveted bulkhead. Note overlaps, boundary angles and flange on longitudinals and web-frames

The sequence of welding sub-assemblies on the ways has already been outlined. Manual arc welding, using heavily coated electrodes, is so well known that no description is necessary except to emphasize that the technique employed in depositing weld metal, the size of electrodes and the current values used as well as the sequence of welding assemblies together, it is believed, will result in a minimum residual stress, distortion and shrinkage.

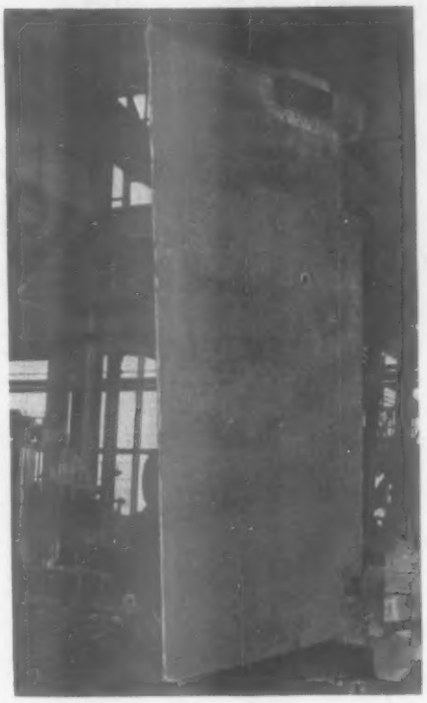


Fig. 18—Ship's rudder—combination of steel castings and plate welded. Weight saved about 10%

Figs. 1 and 2 show the automatic welding machine layout designed to utilize the Unionmelt process in welding shop assemblies. Reference has already been made to sequence of operations employed. Fig. 3 is a close-up view of the tilting table with welded head, etc., in welding position.

Fig. 14 shows extent of the erection of the first 117-ft. section on the ways early in April. It consists of three cargo tanks and a pump room between twin longitudinal bulkheads. It also shows bilge brackets and longitudinals and a section of flat and vertical keel. Fig. 16 shows a section of bottom, vertical keel and two transverse bulkheads.

The above illustrations show fair lines almost entirely free of distortion or warping. Careful check at this time showed less than ¾ in. longitudinal and less than ½ in. transverse shrinkage which is due to greater amount of manual field welding at the after-shaped end. There was no evidence of vessel raising from the keel blocks.

Fig. 17 shows a typical riveted bulkhead. Note the plate overlaps at the seams, the boundary angles and the flanges on longitudinals and web-frames, all of which are eliminated with welded construction. The saving in weight of steel in the welded hull due to such items for the entire hull structure, as noted above, is about 15%.

Conclusions Reached

It is our opinion that operating results, maintenance costs and saving in weight will more than justify the extra expense, if any, necessary to weld vessels and equipment as outlined in this paper. Ultimately welding must lead to a somewhat different shop layout and a somewhat different yard personnel, as it is not a strenuous operation, it requires skill rather than brawn.

Training of Skilled Workers

A recent survey by the National Industrial Conference Board indicates that four out of every five companies have adopted some form of training for industrial work in order to meet present and future needs for skilled workers.

The results of the Conference Board's survey, which covered 473 companies in various industries and in different sections of the country, are presented in a report, "Training for Industry." This report shows that training on the job is the method generally used. Only 8.5% of the companies surveyed are maintaining so-called vestibule schools, which represent a type of training in the plant under special instructors and the assignment of separate machines for that purpose. Systematic apprentice-training is reported by 272 companies, chiefly in the metal-working industries.

The time required for training ranges from one week to more than five years. In those companies having apprentice-training courses, the training period is generally four years. The compensation of persons in training is shown to be at least 50 per cent of the regular rate in over 90 per cent of the companies surveyed, and amounts to 80 per cent of the regular rate in about 32 per cent of the companies.

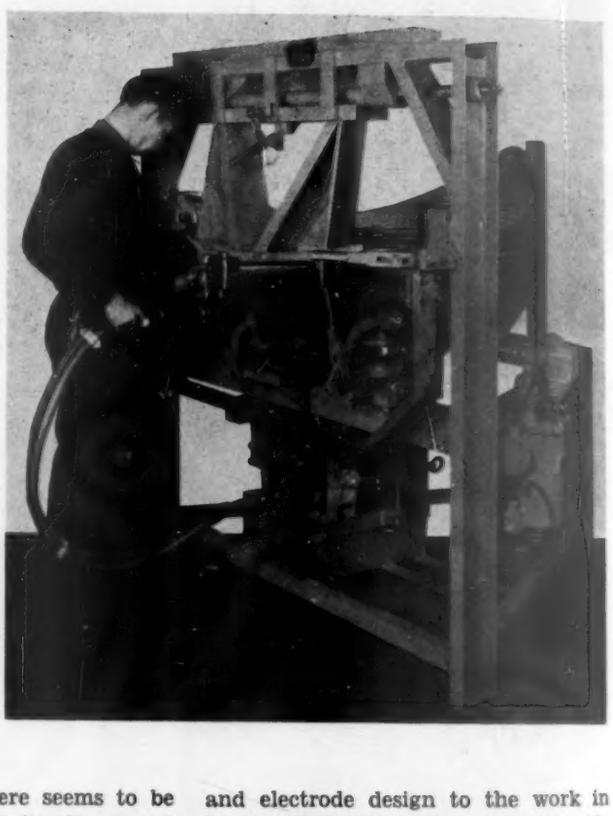
Resistance Welding Expands

Its field of usefulness

Review of basic principles may suggest many new cost-reducing applications in metal working plants — Accurate current timing is essential

By DR. PAUL G. WEILLER

Treasurer, Welding Timer Mfg. Inc., Newark, N. J.



Spot welding is particularly well adapted to light-gauge sheets

THE introduction of timers and of large welders has made resistance welding into a new art. Some manufacturers of metal products are availing themselves of all the latest improvements of the art. The rank and file, however, are reluctant to change to up-to-date high-power equipment. Cost of re-equipping is not the only obstacle. Much sales resistance is created by the fact that modern spot-welding sets have exacting standards of supervision and maintenance.

Spot and butt welding have been used on work pieces so tiny they have to be looked at with a magnifying glass, and on railroad cars and battleship parts as well.

So far spot welding has been at its best on materials no thicker than ⅛ in. in steel and ¼ in. in aluminum, though heavier materials have been successfully welded. So far as I know there has been no serious attempt to spot weld heavy structural sections as used in roof trusses and bridge girders. It is quite likely, however, that attempts in this direction will be made some time in the future.

The same is true of butt welding. Most butt welders today work on sections of 2-in. or less in diameter. Heavy rails have, however, been successfully butt welded.

In flash welding there seems to be hardly any limitations in size except first cost of equipment.

From these few lines it might appear as if resistance welding would be the "cure-all" for nearly all metal-fabricating problems. This is decidedly not so. While most anything can be welded if one wanted it badly enough, there are some definite limitations to the usefulness of resistance welding in regular shop practice. Because welders have to be set up and tooled for particular work for good results, spot and butt welding are primarily mass-production methods and are not at all suitable for use on short runs of various sets of parts which require frequent readjustment of the welder.

To obtain the best possible result from the welding operation, it is necessary to adjust power, pressure, time and electrode design to the work in hand. This may take a considerable amount of time. Electrodes may have to be machined, and also some consumption of material will be necessary since proper settings can be found only by the trial-and-error method. If the job is simple, the cost may amount to a few pounds of scrap sheet and half an hour's time. If the job is more involved or more difficult, it may be a matter of days or even a week or two to determine the best method. It is therefore reasonable to make short runs on spot and butt welders only on the simpler jobs where adjustments are not critical and can be easily made.

If only rough work is desired, adjustments are not so important. In the metal-furniture industry, for instance, sheet and parts from 29 to 14 gauge are welded in the course of the

Resistance welding is primarily a mass production method—Automobile body plants use it to advantage

assembly of a single item on the same welder without changing adjustments. Entire reliance is placed on the operator's skill and judgment in getting proper welds. This is certainly not in accordance with best practice. It is not much of an exaggeration to call such a method a make-shift. Results are very unsatisfactory. Allowance must be made for welds that do not hold by placing more welds on the product than would be necessary if all of them would be perfect. There is always a great deal of burning and surface deterioration which requires expensive finishing to improve the appearance of the piece. This haphazard method originated many years ago when spot welding was still a rough and unreliable method, and it was adopted by the metal-furniture industry because of low cost. As nothing was known then about the proper way of spot welding no attention was paid to welding requirements in the design of the product. This tradition still persists in the metal-furniture industry. Therefore, results obtained with spot welding in this industry are not particularly good.

Another factor which limits spot welding is that of accessibility. The longer the horns of a welder become, the more inefficient it is and the harder it is to handle the work piece. This difficulty has been overcome to a considerable extent by gun welders, bar welders, pinch welders and other special devices. But there still remains a great number of assembly operations which cannot be performed by resistance welding because of poor accessibility.

Nearly all metals can be spot or butt welded. A partial list follows: steel, stainless steel, cast iron, brass, monel metal, nickel silver, phosphor bronze, beryllium copper, aluminum, dural, dowmetal, zinc, die castings and many others too numerous to mention. There are however a few which, while not impossible to weld, are not particularly suitable for this type of assembly. The most important ones in the "black list" are screw-machine brass and pure copper.

Screw Machine Brass

Screw-machine brass contains a small amount of lead. This seems to give the weld a coarse crystalline structure which is very brittle, making it very difficult if not impossible to obtain satisfactory welds.

Pure copper can be welded but the currents required, owing to its high electrical and heat conductivity, are so large as to make spot welding impracticable because of the high primary cost of equipment. Butt welding of copper is being done quite successfully however.

Spot welding was originally used mainly for the assembly of simpler sheet-metal structures. This is still its largest field. Probably the largest volume of sheet-metal spot welding is done in the manufacture of metal furniture and automobile bodies.

In the manufacture of automobile bodies, reliability of welds and speed of operation are of primary importance. Appearance is secondary, except in a few exposed spots like the ventilator covers on top of the hood. There are a great number of timers in use in fabricating automobile bodies. Their use, however, is by no means general as yet.

The metal-furniture industry was probably the first to use spot welding on a larger scale, though rather backward in adopting modern welding equipment.

Kitchenware Applications

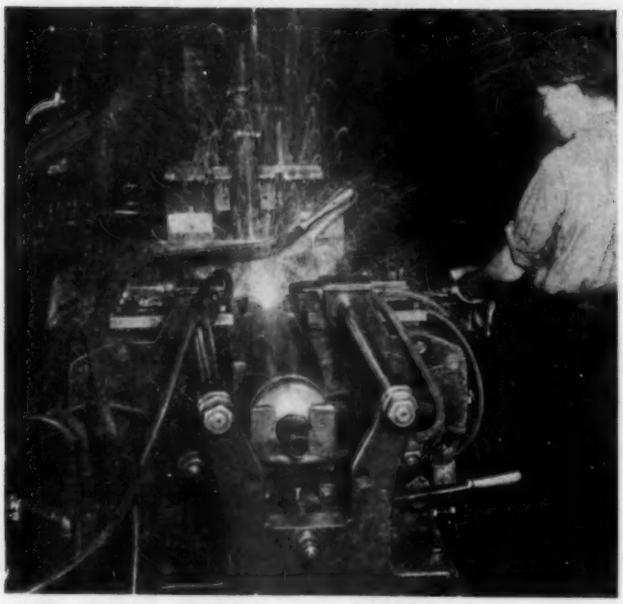
Next in importance is the manufacture of kitchenware. Spot welding is applied mostly to handles on hollowware and covers. A special type of butt flash welding is used in connection with spouts. By the old methods, the spouts were provided with a flange which was welded to the body of the pot with over-lapping spot welds. This makes a primitive type of seam weld, though a tight one. It is however a relatively time-absorbing operation and requires considerable attention by the operator.

This is rapidly being replaced by a peculiar butt-flash-welding method. The spout has no flange. It is introduced into the hollow upper electrode of a large welder in such a fashion that only about ⅛ in. protrudes from the electrode. The spout is then brought into contact with the body of the pot and a large current sufficient to reliably melt the metal all around is passed through the work during a time interval of about two cycles. This makes a reliable and tight seam and produces very little flash. No grinding of the weld is necessary. This method is much faster than the old one and therefore very inexpensive.

Spot welding is extensively used in the manufacture of a new type of kitchen stove, fabricated entirely from steel and stainless steel. In kitchenware and stove manufacturing the use of timers is of great advantage.

For successful enameling it is important to have a perfectly clean surface. Copper articles from the electrodes and certain metal oxides are apt to produce pin holes or colored spots on enamel. Short-time spot welding, sometimes called "shot welding," goes a long way to avoiding these defects without necessitating the grinding of the welded surfaces.

Spot welding is, of course, used on a large scale for the assembling of an infinite number of small metal parts of all sorts. Practically any metal stamping plant uses a number of spot welders. The volume of work in such industries, however, does not compare



Butt flash welding of an automobile muffler

with that passing through the welding departments of automobile, kitchenware and stove plants.

Jobs are of such great variety that it would take volumes to describe them in any detail. It is, however, worth mentioning in this connection that timers made possible the welding of materials which could not be welded on a manufacturing scale before, and also in some cases permitted making of welds that are invisible on one side of the work.

Correct Timing

A normal spot weld made without consideration of surface appearance produces a depression on both sides of the piece even if one electrode is flat. By correct timing and adjustment of electrode pressure it is possible in some cases to make welds that are perfectly flat and invisible on one side of the work. Where this is not practicable, one can make adjustments in such a fashion that welds are raised about 0.002 in. instead of being depressed. This makes it possible to grind off the protruding part with a single short application of a soft-rubber grinding wheel. Without these precautions it is necessary first to hammer out welds with a pein hammer and then grind them off, or to fill them with putty. These expensive operations are eliminated by the method described. Only a few manufacturers have availed themselves of the possibility of making invisible welds.

Spot welding can be put to a great number of uses for which it was not primarily intended. An automatic machine lately devised and put into production welds iridium points to fountain pens at the rate of thirty a minute. This machine made it possible to sell complete fountain pens with a stainless-steel nib and iridium point for much less than a dollar. The same method is also being used for standard gold pens.

Delicate Spot Welding

Spot welding is gradually replacing silver soldering in the manufacture of goggles, eye glasses and watch cases. In the latter instance in particular, some startling results were obtained. A considerable reduction in the manufacturing cost of both cheap and better-grade watch cases followed the use of spot welding.

An interesting example of spot welding is the application of studs to metal plates. Heretofore the job was done by drilling and threading or riveting and, in cases of name plates, by silver soldering. If the parts are properly designed it is quite easy to weld a threaded steel bar cut off on a screw machine directly to brass or steel plates, the weld being entirely invisible. This makes a substantial saving over the older methods.

Other Applications

Spot welding has been used to some extent by manufacturers of machines composed of small parts like linotype machines, postage meters and the like. It is used for assembling chassis and for fastening pins and shafts. Some textile-machine parts which originally were forged are now assembled from stampings and bar stock by butt welding. Chromium-plated brass flashlight cases have been welded after plating without destroying the chromium finish. Microscopical parts of fine instruments are being spot welded with the help of precision timers. So are heavy steel chains. In the latter case, the application of timers has reduced scrap and improved the physical properties considerably. The use of spot welding in marine work and the fabrication of aeroplane parts, and the new stainless-steel and aluminum-alloy trains, is too well known to require discussion.

Welded Cam

An unusual application of spot welding is that of a textile-machine manufacturer. A cam consisting of a hollow cylinder about 3 in. in diameter, inside of which an irregular-shaped groove was to be milled, provided quite a brain teaser. The problem was finally solved by making the cam out of a smooth cylinder of soft steel. The cam parts were punched out from high-carbon steel and finished before assembling. They were then welded into place on the inside of the cylinder.

The few examples described should be sufficient to convince any manufacturer of metal products of the importance of resistance welding as an up-to-date and economical method of fabrication. To employ resistance welding to greatest advantage it is, however, important to consider both its advantages and limitations, just as it is necessary to design any product in such a fashion that it can be properly turned, milled, ground or broached. It is important to consider the peculiarities of spot and butt welding in designing products which have to be assembled by this method. A little forethought in this direction may bring large dividends in economy and also in the form of new lines which could not be profitably made without proper use of resistance welding.

Huge Coking Drums Floated to Destination

At New York Bay the drums were placed in the water, lashed together in pairs with strong steel cables and were protected from contact damage by heavy timbers securely fastened lengthwise. The manholes and all extending projections were also protected by boxes of heavy lumber bolted securely in place. For the trip up the Hudson River and through the Great Lakes one large, ocean-going tug handled the tow, but in the canals and more congested waters the services of another tug were provided to prevent accidents. The dimensions of each of these four drums are:

Length 60 ft.; Weight 175,000 lbs.; Contents 8,900 cu. ft.; Thickness 1 3/16 in. Each drum has 500 ft. of Masterwelded seams and 600 eyes are welded to the inside walls. Wire,

threaded back and forth through these eyes, holds the coke in place during the coking process. When the coke is ready to be removed the wires are withdrawn and the coke, cooled by water, is discharged directly from the coking drums into waiting railroad cars.

The shipment of the four coking drums served as a dress rehearsal for the transfer of a mammoth low-pressure evaporator tower which was shipped by The Kellogg Company to Whiting about October 15. This tower, as far as is known, was the biggest single piece of freight and the heaviest single piece of freight ever to be shipped.

Welding Applications in the Specialty Field

By A. M. MAC FARLAND

In the specialty field, the welding art has been developed and applied to reduce prohibitive costs, and to improve quality. In the manufacture of spark plugs, it is necessary to weld a nickel wire of about 1/16 in. dia. to a 1/8 in. dia. steel wire. This is done by an automatic butt welding machine at the rate of about 250 welds per min. The 1/8 in. steel wire is fed from a reel and care is taken to cut off the end square and smooth. The nickel wire is also cut with a square end, and is butted and accurately centered against the steel wire, with considerable pressure holding the wires in contact.

Then a cam makes an electrical contact, and current from an A-C welding transformer of about 2 K.V.A. capacity, at low voltage flows through the joint. Another cam separates the wires a small fraction of an inch drawing an arc which is allowed to flow for about 1/20 sec. after which the wires are forced together with pressure, and the weld is completed. The jaws of the vise which hold the wires grip close to the weld and are subjected to considerable heat. They are faced with tungsten, made from ¼ in. rod. It is important that the nickel be of a kind adapted to welding. One popular form contains a small percentage of manganese. The welds thus formed are very strong and may be bent at a right angle without breaking.

The machine may be completely automatic in operation, or it may be of a simple hand-operated type, using pre-cut sections of wire, fed one at a time. Instead of using A-C as a current supply, D-C may be used, and a shorter time limit imposed.

An old storage battery, of the kind used in electric trucks, makes a good power house. Two sections, giving 45 volts, or better, are necessary. An ordinary D-C contactor, operated by a hold-in coil and a pedal-controlled push button can be made to give satisfactory service, or a regular welding motor-generator set may be used. A m.g. unit of 200-amp. capacity can be used to flash-weld rods up to about 3/16 in. dia. Some kind of a machine to contact and separate the rods and to forge them together is necessary.

Welding Tungsten To Copper

With such an outfit, tungsten may be welded to copper, for such purposes as lamp filaments. In welding tungsten to copper, the presence of a small amount of iron helps to make a strong weld. A thin band of iron around the junction is a great help. With the outfit above referred to, 1/8 in. tungsten may be welded to copper of equal size.

When using a stranded copper cable, an iron band around the end of the cable serves to keep the strands from separating, and also alloys with the tungsten, to improve the strength of the weld.

With an ordinary spot-welding machine, an experienced operator can make up fixtures enabling the machine to do any amount of trick work. Or merely by making the proper adjustment, the effect may be produced. For example, one shop tried to weld a common 10-32 hexagonal iron nut to thin sheet iron. At first the threads of the nut were fused and holes burned in the sheet-metal. After the time had been cut down to about 1/20 sec. and the current and voltage raised to a good working point to match the timing, the nuts were welded without affecting the thread, and without damaging the sheet metal.

Welding Brass Studs

Sometimes it is desired to attach brass studs to steel plate. On ship bulk-heads, or fabricated construction, brass studs are needed. It is possible to flash weld brass studs to steel plate, by a method similar to that described for spark plugs. Naval brass studs 1/4 in. or 3/8 in. may be welded to the plate so firmly that they may be hammered flat and straightened out and will leave a section of brass on the steel when eventually broken.

It is only necessary to place the stud in contact with the plate; establish the current flow; separate the stud from the plate about 1/16 in. to draw an arc; allow the arc to flow for a suitable period, ranging from 1/2 sec. to several seconds, depending upon the size of the stud. and the current flowing; and then to force the stud against the plate and hold firmly for a short time.

A 200-amp. m.g. welding set will satisfactorily weld up to 1/2 in. dia. studs. It is possible to weld steel studs in this manner, but it is more difficult to handle the various steps and requirements.

Building With Welding

Welded structures, tanks, bridges and buildings are no longer a novelty. A milestone of progress was passed in the adoption by New York City of a new building code which permits the use of welding. Years of research and development, sound engineering designs and years of experience were forerunners of the acceptance of welding by the largest city in the world.

Welding makes possible a lighter, stiffer and more compact joint. The same degree of strength may at times be obtained with savings in cost. Typical examples of the latter are wind and earthquake bracing, girders and trusses. In crowded cities elimination of noise is a determining feature and it is reasonable to expect that the public, aided by noise abatement groups and health bodies, will in time demand ordinances making the use of welding mandatory.

In its program of advancing the use of rolled steel, the steel industry is willing to take its own medicine. Welded steel equipment and welding in maintenance work are now the accepted methods. This new accept-

ance of welding presents a challenge which the industry and the American Welding Society accept. To meet this challenge of responsibility there will be stringent code requirements covering materials, design and workmanship. Education, training and research must go hand in hand.

In one particular field—bridge construction—some of the European countries have progressed further than this country in actual applications. Some twenty or more important welded railway and highway bridges have been recently constructed in Germany.

These applications followed exhaustive preliminary experiments and theoretical investigations. In the applications of welding to buildings and machinery in general, progress has probably been greater in this country than elsewhere.

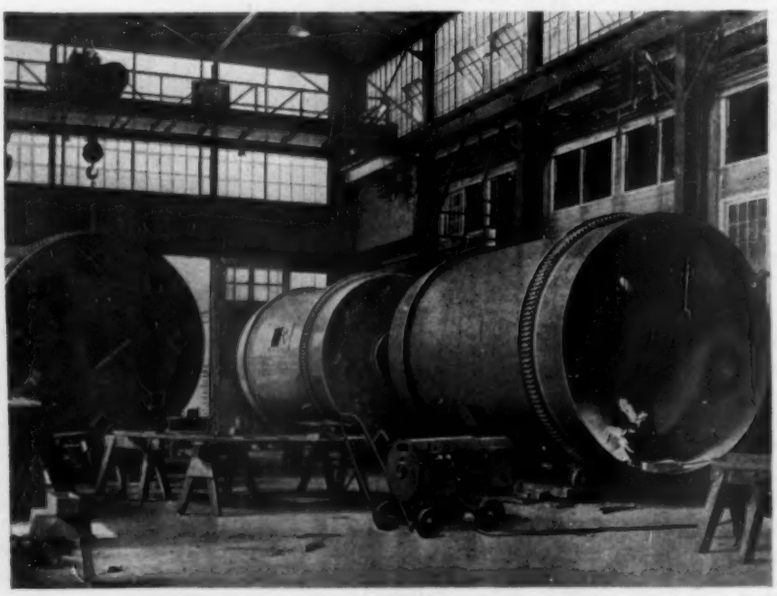
Production of Sheet Metal Brewery Equipment

The Galland-Henning Co., of Milwaukee, Wis., one of the leading manufacturers of equipment for the brewing industry, has found that by changing from riveted to arc welded construction it is able to materially step up production schedules.

A concrete example of this is shown in the welding job here illustrated. This massive drum is used for malt germination—with a capacity of 600 bushels of malt. Faced with an order for twelve of these drums at one time, the Galland-Henning Co. found arc welding to be a great help in that it enabled them, without additional overhead, to increase production from three drums per week under riveted construction, to five drums per week by using arc welding.

Each of these drums requires 400 lineal ft. of welding. They are made of rolled steel plates from 5/16 to ⅜ in. thick, with overall dimensions 28 ft. by 10½ ft. Their massiveness makes arc welding even more valuable as it greatly decreases the total weight of each unit, yet maintains the proper strength. It is also claimed that from a sales angle, these drums are much better in appearance than the old type—much lighter and easier to keep clean.

Working on this job are four 400-amp., motor driven P&H-Hansen Smootharc welders, laying fillet welds with Smootharc Welding Electrodes.



Arc welding speeds production of massive brewery drum

British Hold First Welding Exposition

When he opened the biennial Engineering, Welding and Marine Exposition in London late in September, Engineer Vice-Admiral Sir Harold Brown (honorary president of the exposition) congratulated the welding trade for participating for the first time in the exposition. "This is the first exposition at which the welding industry as a whole has ever been represented in the United Kingdom," Sir Harold declared.

The exposition provided a representative display of the advances which have taken place in engineering, foundry trades and welding during recent years. Official visits were arranged for a large number of technical societies and institutions. In the welding section of the exposition 16 well-known firms were represented with extensive displays of apparatus, both oxy-acetylene and electric, and with practical demonstrations.

The exhibit of the British Acetylene Association was designed to give a comprehensive idea of the wide field of application of the oxy-acetylene processes. The British Oxygen Co. showed interesting oxy-acetylene welding and cutting equipment comprising blowpipes of various types for lead-burning, brazing, heat treatment and steel-surfacing, pressure regulators, hand and machine cutters, and ferrous and non-ferrous electrodes for producing weld metal having different characteristics of strength, ductility, hardness and susceptibility to heat treatment.

Welding and cutting apparatus and electrodes were shown by British Industrial Gases, a special feature being the multi-stage pressure regulators for giving a constant feed of gas. In the display of Hancock and Co. ((Engineers), Ltd., was a complete range of oxygen cutting machines in operation. Another display which attracted wide interest was that of C. S. Milne & Co., which contained, along with numerous accessories, examples of new carbide-to-water, self-desludging, automatic acetylene generators.

The Metropolitan-Vickers Electrical Co., included in its exhibit both direct and alternating-current sets, among the latter being a high-frequency rotary equipment designed specifically for welding thin plates. The English Electric Co. featured a multi-arc welding equipment, comprising a transformer and three sizes of welding regulators, together with four portable a-c equipments of different sizes. Also featured was a portable a-c. type suitable for welding light-gauge materials.

Both direct and alternating current machines were displayed by Murex Welding Processes, together with an impressive range of electrodes which included large gauge types suitable for mild steel. Among the exhibits of Philips Lamps was a machine for welding thin sheet metal, a dual-current welder, bare and coated electrodes, and industrial x-ray equipment for the visual and radiographic examination of welds.

The exposition did a great deal to reveal the solid and growing strength of the welding industry in Great Britain.

New Equipment Developments

Automatic Gasfluxer For Brazing Work

The Automatic Gasflux Co., 700 Public Square Bldg., Cleveland, Ohio, report they have perfected a new machine that automatically dispenses brazing flux. The gas line runs through the Gasfluxer and as the gas passes through, it is impregnated with a special flux. The flux then travels with the gas to the torch tip and is expelled in the flame.

The special flux used, they say, is the result of long laboratory research by Gasflux engineers. It has a very low melting point and coupled with the fact that it is dispensed in a minimum quantity heretofore unobtainable, the flux creeps ahead of and is always under the brazing puddle. It penetrates thoroughly and quickly, preparing the metals in such a way that an unusually tight joint is secured.

Automatic Gasfluxer unit for brazing

In using these fluxers, the makers state, that the obnoxious fumes sometimes caused during the brazing process, are not present. It is believed that this is because a minimum, regulated quantity of flux is used. At present, this process is used for the application of bronze to steel, semi-steel, malleable iron, galvanized iron, nickel, copper, monel and other alloys. The savings claimed are: much faster brazing, fewer rejects, lack of porosity in the joining material, less filler metal used, less grinding and absence of pickling. The automatic regulation and dispensing of the flux, makes the entire brazing operation automatic—that is, the gas and oxygen are regulated, as well as the flux.

The Gasfluxer and Gasflux it is claimed can be used with all types of equipment as well as any standard gas. No changes are required in torches, tips or regulators. It is stated that any experienced welder can use the equipment without special instruction. One gasfluxer of the proper size will provide flux for as many torches as required on a single gas line.

Duro Insulated Holder Announced

A NEW DURO HOLDER possessing all the features of the standard Duro holder, including practical replacement parts with the additional advantage of complete insulation has been announced by the Churchward Engineering Co., Inc., New Haven, Conn.

Protected completely from accidental arcing it should prove of advantage to operators welding near finished surfaces or in confined places. It is ruggedly built, cool, light and well balanced. Descriptive literature will be sent on request.

New One-Piece Fibre Welding Helmet

The Fibre-Metal Products Co., Chester, Pa., have recently introduced to the trade a new one-piece fibre helmet, which in size, shape, weight and general utility is similar to other types of helmets, plus the added safety of not having a single seam in its entire construction. The only rivets it contains are those holding the headgear, chin rest and glass holder in place, and these are so arranged it is claimed that it is absolutely impossible for any flashes to penetrate to the operator. Another feature, furnished when desired is an aluminum lift front glass holder.

Seamless, one-piece fibre helmet also features real leather sweat band

In the manufacture of these helmets a battery of presses is used, each carrying steam pressures up to 300 lbs. A sheet of fibre, cut to size, is dipped in water and inserted in a die heated to a previously determined temperature. The pressure is gradually exerted, and the helmet is slowly formed. Before being completed, however, the presses are stopped to allow the fibre to set. After a few moments the pressure is resumed, and a helmet, complete, except for trimming and the addition of shields, head gear and chin rests is removed.

One-piece fibre welding helmet

Science Diagnoses Reading Defects

How can people become more efficient readers? The Ophthalm-O-Graph and Metron-O-Scope, instruments developed by American Optical Company's Bureau of Visual Science will help, it is claimed. This organization diagnoses and corrects

reading defects and assists in revolutionizing the art of reading.

The Ophthalm-O-Graph, briefly, is a double-barreled moving picture camera which photographs light reflected from the eyes as one reads. The resultant film reflects the subject's reading habits, such as reading speed, pauses in reading, retracing to understand what has been read, and other defects. By comparison with standards of reading, the eye specialist or educator can then determine how efficiently the subject reads.

If there are reading defects, the Metron-O-Scope is used to correct and train the faulty habits. This instrument has three shutters in front which disappear in sequence, exposing a third of a line of words printed on a roll of paper which unfolds in the same manner as a player-piano roll. The subject is thereby forced to read correctly, for the operation of the instrument will not permit him to pause.

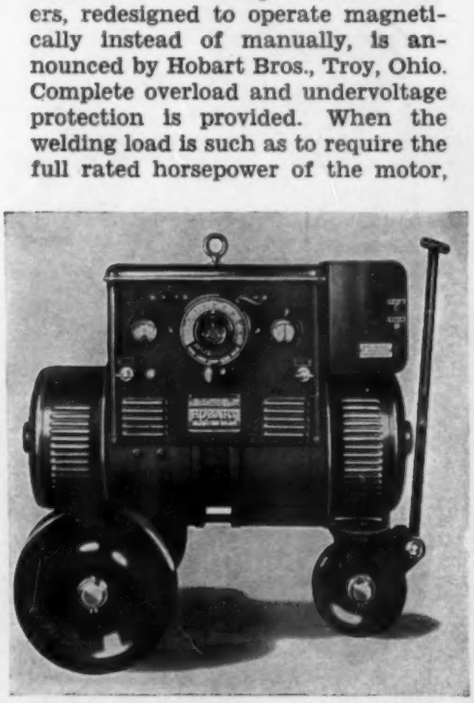
Small Capacity Spot Welder

A new type spot welder which is adaptable for use in the smaller industrial shops, and can be used on 110-volt, 60-cycle current, has been placed on the market by the CRAFTE WELD ENGINEERING COMPANY, 22747 Woodward Ave., Detroit, Mich.

Hobart Magnetically Controlled Welders

A new line of simplified arc welders, redesigned to operate magnetically instead of manually, is announced by Hobart Bros., Troy, Ohio. Complete overload and undervoltage protection is provided. When the welding load is such as to require the full rated horsepower of the motor, the operator "flips" a small toggle switch to "high" position and presses the starter button. The motor then starts under reduced voltage and with about one-third the starting current usually drawn when starting across the line. As soon as the machine comes up to speed, the switch automatically changes over to the normal, full-load running position.

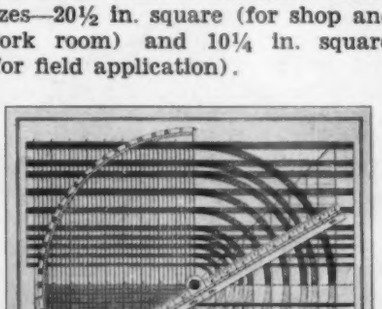
If one-half the rated horsepower of the machine is sufficient for the job at hand, the operator flips the toggle switch to "low" position. In this case, when the starter button is pressed, the machine starts and runs without changing over to the full-load position.



Hobart welder redesigned to save current costs

New Rhoade's Pipe Layout Chart and Manual

The laying out of pipe angles, offsets, saddles, has often resulted in a considerable amount of time-consuming effort. Many different home-made or intricate pipe layout devices have been on the market. For many years RUSSEL G. RHOADES, closely connected with the laying of pipelines, has worked on an easily understandable layout chart which has met with the approval of engineers, draftsmen and pipe layout men. The chart itself is available in two sizes—20½ in. square (for shop and work room) and 10¼ in. square (for field application).

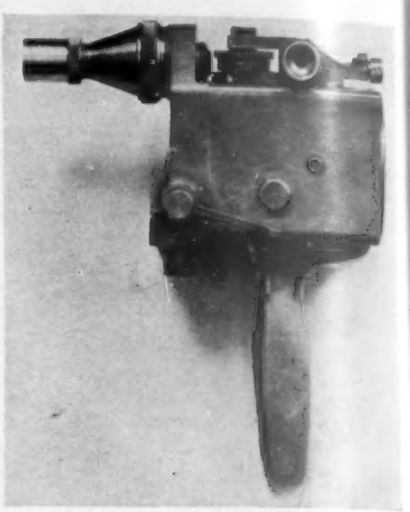


Rhoade's pipe layout chart

These charts supply the answer to every type of pipe angle, dimensions, and angles in pipe offsets or for pipe saddles, as well as compound offsets, and does this without any mathematical computations or time-consuming measurements. A clear and concise manual accompanies these charts to explain the simplicity of their application. These charts are comprehensive enough for the engineer and draftsmen and yet so simple that they can be used readily by field men. The charts and manuals are sold nationally by the VICTOR EQUIPMENT COMPANY and distributors.

Economy Claimed for New Metal Spray Gun

It is claimed that the new Majestic Metalayer will deposit about 100 per cent more metal in a given time, with less oxygen and acetylene consumption per pound of metal deposit. The Metals Coating Co. of America, 493 N. 3rd St., Philadelphia, claim to have originated and developed certain new features regarding the sprayed molten metal process. The problem of feeding heavier wire at higher speed required a new method of gearing and increased bearing capacity.



New Majestic Metalayer

With an efficient design of turbine, only a small increase in pressure and volume of compressed air is required over tools of lower capacity. The train of gearing from the turbine to the final feed roll consists of two hardened worms, one bronze and one fibre gear, respectively, of special composition, and the entire gear assembly is enclosed in one compartment containing grease.

The feed rolls are conveniently engaged by an adjustable latch bolt operated with a single motion, facilitating speedy engagement, sensitive control and quick release. The gun can be lighted and flames adjusted, with or without, the wire feeding, thus eliminating waste of wire during adjustment. No moving parts are exposed.

It is claimed that the "Majestic" gun is well-balanced and the final adjustment and control of oxygen, acetylene and compressed air are made with one movement of the valve handle. Oxygen, acetylene and air connections are readily replaced and are of standard sizes and shapes. The unit can be supplied with a standard handle for manual operation or adjustable tool post holder for mechanical operation.

City of Chicago Revises Building Code to

Permit Structural Welding

Officially approved at regular meeting November 3, 1937—Adopts A. W. S. Codes for major provisions

AT ITS regular meeting November 3, 1937, the City Council of the City of Chicago approved a partial revision of the Building Code, which permits the use of structural welding. This represents a substantial engineering victory for welded fabrication in building construction, because with New York and Chicago, the two largest cities in the United States approving structural welding, it is reasonable to expect other important cities to fall in line.

We present below the important features of the revised building code as it applies to welding. Under Article 4001—General, covering steel and metal construction, the revised ordinance provides:

"(a) *Structural Steel.* The design, fabrication and erection of steel and metal construction shall be in accordance with the 'Specification for the Design, Fabrication and Erection of Structural Steel for Buildings' as adopted by the American Institute of Steel Construction and revised June 24, 1936, for steel made by the open-hearth process, except as otherwise provided in this ordinance.

"(b) *Welding.* The design and execution of welding shall be in accordance with 'Code I, Part A, Code for Fusion Welding and Gas Cutting in Building Construction' of the American Welding Society, Edition of 1934, including 'Appendices I, II, III and IV.' Welding, or any combination of riveting, bolting and welding, may be used for the connecting or assembling of component parts of metal beams, columns, trusses or other members, and for connecting such members to one another to make up the frame of a building or a structure; except that the strength of any one (1) joint shall be considered as the strength of the welded joints alone or as the strength of the rivets or bolts. Surfaces to be welded shall be free from loose mill scale, rust, paint or other foreign matter. No welding shall be performed in a strong wind or in rain until adequate protection has been provided."

Under Article 4002—Materials and Stresses, the revised ordinance specifies that structural materials shall be at least equal to the requirements of the Standard and Tentative Standard Specifications of the American Society for Testing Materials. In regard to welding materials the revised ordinance provides:

"*Welding Materials:* Electrodes, welding wire, and welding rods used for welding shall be at least equal to the requirements of the Code of the American Welding Society, edition of 1934, for such materials."

Under Paragraph 4002.02 covering stresses, the ordinance provides that the maximum tensile stress in psi. shall not exceed the values given in the following table:

"Structural Grade Steel	18,000
Silicon Steel	24,000
Cast Steel	15,000
Wrought Iron	12,000
Cast Iron	None
Rivet Steel (heads not countersunk or flattened to less than three-eighths (⅜) inch)	13,500
Metal in welds, bare wire	13,000
Metal in welds, shielded arc	16,000
Bolts in tension of structural grade steel	16,000
Bolts in tension of special high strength alloy steel ....1-3 yield point as of A.S.T.M. specification."	

It will be noted in the above table that the allowable tensile stress in weld metal is 13,000 psi. for bare wire and 16,000 psi for shielded arc wire, the latter figure exceeding the allowable tensile stress in rivet steel, which is 13,500 psi.

In respect to maximum allowable compressive stress the new building ordinance provides that on the gross section of any compression member with a ratio (1/r) not greater than (12), shall not exceed the following values for the materials indicated:

"Structural Grade Steel	18,000
Silicon Steel	24,000
Cast Steel	15,000
Wrought Iron	10,000
Cast Iron	10,000
Metal in welds, compression on section through throat of butt weld	15,000"

In the above table of allowable compressive stress, the ratio (1/r) is explained below:

1 = Unsupported length of member in inches.

r = Least radius of gyration of gross section in inches.

Under maximum allowable bending stresses, the revised ordinance provides that the total stress in psi. in the extreme fibre of any rolled shape or built up member in bending shall not exceed the following values:

"Structural Grade Steel	18,000
Silicon Steel	24,000
Cast Steel	15,000
Wrought Iron	12,000
Cast Iron, tension fibers	3,000
Cast Iron, compression fibers	10,000
Metal in welds, bare wire, tension	13,000
Metal in welds, shielded arc, tension	16,000
Metal in welds—compression	15,000"

Under shear values, the new ordinance provides that the maximum allowable shear stress in psi. shall not exceed these values:

"Pins	13,500
Power-driven rivets	13,500
Turned bolts in reamed holes, with a clearance of not more than one-fiftieth (1-50) inch	13,500
Hand-driven rivets	10,000
Unfinished bolts	10,000
Metal in welds	11,300
Shear on gross section of girder webs—	
Structural grade steel	13,000
Silicon steel	16,000"

Under Article 4004—Construction Provisions, the revised ordinance specifies the method of testing welded structures:

"Welds shall be subjected to test in such manner as to be stressed in shear to one and one-half (1½) times the computed shear reaction. At least three (3) per cent of the welds in primary members, and not less than four (4) tests of primary members, and at least one (1) per cent of the welds in secondary members in each story shall be so tested as the work progresses and before it is encased in concrete or otherwise concealed. Should any of the primary joints fail under these tests, additional tests of five (5) per cent of the total number of primary joints shall be made for each failure. Should any of the secondary joints fail under these tests, additional tests of one (1) per cent of the total number of secondary joints shall be made for each failure. Any joints that have failed or show any signs of material damage as a result of such tests, shall be cut out, rewelded and retested. In the case of shop welding such tests may be required before the member is erected at the building. All welding shall be done under supervision of a laboratory of recognized standing.

"Commissioner of Buildings shall be furnished, at the expense of the owner, with a certificate, from a laboratory of recognized standing, certifying that the tests required above have been made and giving the results of said tests.

"Upon completion of all structural welding operations and required tests thereof, the architect or engineer responsible for the design of the structure, shall furnish to the Commissioner of Buildings a certificate, showing that the fabrication and erection of such welded structure has fulfilled the requirements of his design in every particular."

News of the Industry

I. A. A. Meets in Birmingham

The 38th annual meeting of the I.A.A. was held in Birmingham, Ala., November 10, 11 and 12. J. L. Perry, president, Tennessee Coal, Iron and Railroad Co., presented the address of welcome as part of the opening luncheon program at the Tutwiler Hotel, November 10. He was followed by Dr. James Shelby Thomas, president of Chrysler Institute of Engineering, Detroit. Dr. Thomas' subject was "New Frontiers For Smart People", and he handled his inspirational talk very creditably.

Another high point of the 38th annual meeting was the award of the Morehead Medal to H. Sidney Smith, consulting engineer, "for his vision, inspirational guidance, and aggressive cooperation in the advancement of the acetylene industry." This was the second meritorious award presented to Mr. Smith within the last month. It was probably the only instance on record where two outstanding engineering awards were presented to the same man almost at the same time.

A total of fifteen interesting papers were presented at the afternoon sessions. Attendance at these technical meetings was remarkably high and well maintained until closing of the session each day. The round table discussions at Phillips High School broke all I.A.A. attendance records. A complete report and some of the outstanding technical papers will be published in our December issue.

Harnischfeger Corp., Milwaukee, Wisc., makers of Smootharc welding equipment, had a stopper in their booth at the National Metal Show in Atlantic City last month. The casual observer up and down the aisles of the show saw a strange "duck" in the seat of a roadster trying to decide which of two steering wheels would keep the crate on the road. The lack of explanatory placards was enough to get the onlooker more than casually interested, so that the men at the booth could tell him about "Sammy Smootharc," another wax "jigger" with a contented smile who did tricks with a rod when the switch on his hip was twisted between a firm thumb and first finger. "Sammy," electrical robot, lowered his own helmet, struck an arc and welded for a few seconds and then raised his helmet and gazed around with a pleased

"Sammy Smootharc"—A welding robot

expression. The illusion of welding was accomplished by a nitrogen blue bulb for the light of the welding arc and a spark through a Ford coil to a spark plug gave the necessary sputtering sound. Those Model T's just won't give up. This novel idea kept the booth busy where welding-minded engineers were given data on Smootharc welders and electrodes.

Program of 13th Annual Purdue Conference

We present below the program of the forthcoming Purdue Welding Conference, December 9-10, which is sponsored by the Department of Practical Mechanics and Engineering Extension Department. All meetings will be held in Michael Golden shops at Purdue University, Lafayette, Ind.

THURSDAY, DECEMBER 9

9:00 A.M.—

Registration, Michael Golden Shops.

Exhibits and Demonstrations.

10:30 A.M.—

Opening Session.

Announcements.

What the Exhibitors Have to Show
Brief statements by representatives of companies concerning exhibits and demonstrations.

Exhibits and Demonstrations.

1:00 P.M—

Exhibits and Demonstrations.

1:30 P.M—

The Physico-Chemical Basis of Welding Electrode Coatings.
J. C. Joublanc, chief metallurgist, Harnischfeger Corp., Milwaukee, Wis.

X-ray Technique for Inspecting Welds.
F. W. Paine, radiologist, Claud S. Gordon Co., Chicago, Ill.

Flame Hardening
Russell Pursel, service engineer, National Cylinder Gas Co., Chicago, Ill.

Exhibits and Demonstrations.

7:00 P.M.—

Exhibits and Demonstrations.

7:30 P.M.—

Design and Fabrication of Welded Parts from Rolled Steel.
J. D. Gordon, general manager, Fabricating Division, The Taylor-Winfield Corp., Detroit, Mich.

FRIDAY, DECEMBER 10

8:00 A.M.—

Exhibits and Demonstrations.

9:00 A.M.—

Modern Machine Cutting.
R. F. Helmkamp, Applied Engineering Dept., Air Reduction Sales Co., New York, N. Y.

Student Course for Welders.
L. A. Wilkin, development engineer, Graver Tank & Mfg. Co., Inc., East Chicago, Ind.

Low-Alloy Steels.
Dr. J. C. Hodge, The Babcock and Wilcox Co., Barberton, Ohio.

Exhibits and Demonstrations.

1:00 P.M.—

Exhibits and Demonstrations.

1:30 P.M.—

Latest Welding and Fabrication Practice.
W. R. Bernardi, manager, Welding Section, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Joining Copper Bus-bars with Brazing Alloys.
R. A. Goeller, vice-president, Hatzel & Buehler, Inc., New York, N. Y.

General Maintenance.
W. B. Browning, service engineer, The Linde Air Products Co., Chicago, Ill.

Exhibits and Demonstrations.

Dr. Paul Dyer Merica, director of research of the International Nickel Co. and vice president of the International Nickel Co. of Canada, has been awarded the 1938 John Fritz Gold Medal, highest of American engineering honors, for "important contributions to the development of alloys for industrial uses," it is announced. The award is made annually for notable scientific or industrial achievement by a board composed of representatives of the four national engineering societies of civil, mining and metallurgical, mechanical, and electrical engineers.

A COOPERATIVE EDUCATIONAL enterprise which will link the Westinghouse Electric and Mfg. Co. and the Carnegie Institute of Technology in a new program of undergraduate engineering training was announced recently by President Robert E. Doherty of Carnegie Tech. To make this project possible, and in recognition of other educational services which are being rendered by Carnegie Tech, especially in the evening school, the Westinghouse Company has appropriated $200,000 to the school.

The new cooperative program, which will go into effect at the beginning of the next school year, will make it possible for a number of students with superior qualifications to take the usual technical courses for a degree and, during the same period, to get extensive shop and engineering experience and training in the Westinghouse plant. Of the group of students who will be selected to follow the cooperative course, a number, perhaps ten each year, will receive George Westinghouse scholarships. A George Westinghouse Professorship of Engineering will also be established, and one of the duties of the holder of this position will be the supervision of the cooperative program.

ELEVATOR FOR "GIANT EYE"

Work has been started by the Edward G. Budd Mfg. Co., Philadelphia, Pa., on a stainless steel, light-weight elevator platform which will be installed inside the dome of the 200-in. reflector telescope to be erected on Mt. Palomar, Calif. The elevator, which will transport astronomers from the floor of the world's largest observatory to the prime focus point, is being fabricated through use of the Shotweld process developed by the Budd Co.

While the prime focus elevator is not a large structure, its weight and strength are of the utmost importance. The conveyance will move a distance of 77 ft. along one of the main arch supports of the dome. The vertical travel distance will be about 45 ft.

K. L. HANSEN, member of the American Institute of Electrical Engineers and the American Welding Society, addressed the Baltimore section of the A.I.E.E. on Wednesday, October 20, in Maryland Hall located on the campus of Johns Hopkin's University.

Speaking on "The Electric Arc as a Welding Tool," Mr. Hansen discussed the characteristics of welding generators required to meet the exacting conditions of the welding circuit, the effect of current fluctuations in the arc circuit, the effect of shielding the arc for typical arc welding applications. He illustrated a number of points by the use of lantern slides.

To meet the increasing demand for instruction in welding, LEWIS INSTITUTE, Chicago, has recently added welding courses to its engineering curriculum.

AN ELECTRIC WELDING SCHOOL was recently established by the Navy Department at the destroyer base, in San Diego, Calif. Instruction is under the direction of C. S. Brown, C.S.F.

ADDITIONAL EQUIPMENT EXHIBITS AT NATIONAL METAL SHOW

Information regarding exhibits of Air Reduction Sales Co., New York, and Wilson Welder and Metals Co., Inc., New York, was received too late to include in our tabulation of exhibits last month. Herewith is a description of Air Reduction Sales Co. exhibit (Booths E62-80):

A representative group (in operation) of its comprehensive line of flame cutting machines. Their range extends from the cutting of lightest gauge steel plate to steel slabs, forgings and castings approaching 30 in. in thickness. They will cut in straight lines or in intricate contours, either vertical to the surface or at an angle. The work these machines will do in steel is comparable to that accomplished with a band saw in wood. They will follow a predetermined path with accuracy, making a kerf in the smaller thicknesses scarcely wider than a saw blade, and with a finish that is suitable for many purposes without machining.

Types range from the torch mounted on a mortor-driven carriage and guided by hand to the templet-guided machine which cuts, without change of original set-up, many duplicates of the same design, using multiple torches centrally controlled from the operator's station.

The No. 20 Travograph, the No. 6A Oxygraph, and the No. 4 Radiagraph were displayed and demonstrated. The No. 10 Travograph, the No. 5 Camograph and the Round Bar Stock Cutting Machine were displayed. In addition to this demonstration in mechanical gas cutting, flame hardening with the oxy-acetylene torch as well as the new multiple-layer welding of pipe were demonstrated. Hard-facing with Stoody products, Airco-brazing of Walseal Fittings, and the use of the new low temperature brazing alloy Sil-Fos were also demonstrated.

The exhibit of Wilson Welder and Metals Co., Inc. (Booths E-62-80) comprised the complete line of Wilson electric arc welding machines. A feature of the Wilson exhibit was the demonstration of the 300-ampere motor generator set.

Construction

PERMISSION WAS RECENTLY GRANTED by the city council of Pittsburgh, Pa., for the construction of an all-welded steel frame building, the first in that city to be welded. The building will be the new Women's Hospital and the contractors are Stone & Webster Engineering Co., Pittsburgh.

THE DRAVO CORP., Neville Island, near Pittsburgh, Pa., recently began work on a large amount of materials for the Pickwick and the Gunthersville Dams, on the Tennessee River. The work consists of furnishing 756 steel wheels 36 in. in diameter and includes axles. Also included in the contract are 84 gates for the dams. These gates are 20 ft. high and 42 ft. wide, and will require approximately 5,460 tons of steel plates. The plates will be butt welded together and welded to a steel framework.

AT THE REQUEST of the United States engineers of the Vicksburg district, government inspectors at Pittsburgh, Pa., will supervise the fabrication of more than 10,000 ft. of steel pipe. The pipe, of 24-in. inside diameter, will be welded and shipped in sections of 12 ft. 10 in. long. It will be used for the Sardis Dam project, near Vicksburg.

UNITED STATES ENGINEERS of the Louisville district opened bids October 19 for the construction and delivery afloat of three maneuver boat hulls, derricks, and framing for cabins, which are to be of welded construction. The boats are to be 75 ft. long, 28 ft. wide, with a depth of 4.3 ft.

A NEW LIGHT-WEIGHT, stainless steel five-car air-conditioned train will soon be operated on a fast schedule, two round trips daily between Philadelphia and New York City by the Reading Railway System. This train is being built by the Edward G. Budd Mfg. Co., Philadelphia. The cars are luxuriously appointed with interiors of bright and modern color combinations. Each of the three reclining chair cars has a smoking lounge room, while the center car is fitted with a kitchen, dining room and cocktail lounge. The end car is a

spacious observation lounge. This streamliner is to be pulled by a new steam locomotive sheathed in shining stainless steel.

THE RHEEM MFG. CO., of South Gate, Calif., manufacturers of welded tanks, water heaters, etc., recently began the construction of a $50,000 addition to its plant at 4361 Firestone Blvd. The building is a steel structure, much of which will be welded.

PROW & LEFFLER, welding contractors, of El Monte, Calif., were recently awarded a contract for the welding and furnishing of pipe for a water system for the Omart Investment Company's dude ranches at Palmdale, Calif. This work will aggregate 4,400 ft. of three-inch pipe, 1,400 ft. of four-inch, and 6,000 ft. of two-inch pipe. Welding will be by the oxy-acetylene process.

AN UNUSUAL PIECE of construction accomplished largely through welding has just been brought to our attention. A huge plow which turns a furrow six feet deep was recently built at Bolsa, Calif. This large implement was designed for the purpose of bringing to the surface rich loam soil in the Santa Ana River (Calif.) plains, buried by a flood in 1916 under a deep layer of sand deposit. The moldboard of the plow, which in operation is drawn by two 95-hp. diesel driven tractors, stands over seven feet high and was fabricated from a single piece of heavy steel plate. The job was completed in two weeks at a cost of approximately $3,400.

THE HUMBLE OIL & REFINING CO., of Houston, Texas, will soon commence the construction of a 2,000-barrel natural gasoline plant in the Dickson oil field, of Galveston County. The plant will be a well-pressure type, utilizing welded fabrication, with a capacity for 20,000,000 cu. ft. of gas daily. In connection with this project this company will construct a 24-mile welded pipe line.

FIRST WELDED SHIP LAUNCHED FOR BRITISH NAVY

The British Navy, after the most careful investigation, has finally been won over to the manifold virtues of welding for naval construction. The minesweeper Seagull, the first rivetless vessel to be constructed for the Navy, was launched at Devonport Dockyard at the end of October, 1937.

The Seagull, with a displacement of 875 tons, is a ship of the Halcyon class and was laid down in July. She has been electrically-welded throughout. The vessel will carry armament of two 4-in. anti-aircraft guns and five smaller guns. She will have a speed of 17 knots.

E. C. BINDER, chief surveyor of the American Bureau of Shipping, has completed making the first tests on one of three tank barges, of which both the hulls and the tanks are welded. Tests were made at the plant of the Marietta Mfg. Co., Point Pleasant, W. Va., where the vessels are being constructed. The first of the barges was launched in October.

ELECTRO METALLURGICAL CO., unit of Union Carbide and Carbon Corp., has contracted to purchase from the Tennessee Valley Authority a large block of industrial power which it proposes to use at a new plant to be located in the Wilson Dam, Ala. area. The contract requires that the Authority be prepared to furnish as much as 40,000 kw. of power by 1941 should the company decide to utilize such amount. The proposed plant will be constructed principally for the manufacture of ferro-alloys, calcium carbide, and other electric-furnace products.

THE DRAVO CORP., Pittsburgh, Pa., has finished fabricating two steel barges of the welded, lighter type at its Neville Island yards in Pittsburgh, for the Philadelphia & Reading Company. The finished plates have been shipped to Wilmington, Del., where the material will be assembled at the marine yards of the corporation and launched.

A. W. S. Activities

KANSAS CITY SECTION of The American Welding Society held its October meeting on the 25th in the Kansas City Power and Light Building. WALTER VOIGTLANDER, chief engineer, Union Wire Rope Co., was the speaker of the evening. His topic for discussion was "Comparison of Electric Welding and Brazing High Carbon Wire for Wire Rope."

DETROIT SECTION, American Welding Society, opened its 1937-38 season October 6, with a meeting in the Detroit Edison auditorium. About 350 men were in attendance. WILLIAM ANDERSON, vice-president of Taylor-Winfield Corp., presided as chairman and introduced the speaker of the evening, JOHN D. GORDON, general manager of the fabricating division of Taylor-Winfield Corp. Mr. Gordon's talk, illustrated with motion pictures, was entitled, "Rolled Steel Construction in Machine Design."

The first meeting of the PITTSBURGH SECTION of the American Welding Society for the 1937-1938 season, was held October 13 in the Roosevelt Hotel, Pittsburgh. Newly elected officers of the section are: Leon C. Bibber, welding engineer, Carnegie-Illinois Steel Corp., chairman; J. O. Rinek, vice-president, Universal Steel Corp., vice-chairman; J. F. Minnotte, secretary-treasurer, Minnotte Brothers Co., secretary; and W. W. Reddie, Motor Sales Division, Westinghouse Electric & Mfg. Co., representative on national board of directors. The latter two men held the same offices last year. A. E. Gibson, president of the American Welding Society, spoke at the meeting, his subject being, "The Use of Rolled Steel in Welded Construction."

THE LOS ANGELES SECTION of the American Welding Society diverted a bit from welding subjects at its last meeting, which was held October 21st at the Central Manufacturing District Club, 4814 Loma Vista Ave. Following the usual 6:30 dinner, an entertaining sound film was presented, through the courtesy of the Union Oil Company, entitled "Finny Fighters". The film depicted some very exciting experiences in deep sea fishing off the coast of Mexico.

Another feature of the meeting was an instructive talk by ROBERT J. BAUER, general manager of the Better Business Bureau, of Los Angeles. Mr. Bauer's talk was on the subject, "Rackets of Today".

THE SAN FRANCISCO SECTION of the American Welding Society held its October meeting the evening of the 22nd at the South San Francisco plant of the Western Pipe & Steel Co. The meeting was held at the steel plant in order to give members and guests an opportunity of observing the actual operations of steel fabrication work, and was interesting to both the technical and practical-minded visitors. The practical side of shop fabrication of American Petroleum Institute, A.S.M.E. pressure vessels for oil refineries and varied chemical industries was discussed by H. S. BRINK, boiler shop foreman of the steel company. Mr. Brink answered many questions and revealed some interesting facts about this type of fabrication.

NEW YORK SECTION A.W.S., held its last meeting on Wednesday, November 17th, at Engineering Societies building, 33 West 39th St. This was a joint meeting with the American Society of Civil Engineers, Metropolitan Section. H. H. Moss, development engineer with The Linde Air Products Co. presented the subject "New Developments in the Flame Cutting of High-Tensile Structural Steel." C. F. GOODRICH, chief engineer, Ameri-

Quick welding repairs with Tobin Bronze

Save weeks of delay for industry

FROM every part of the country come stories of the money and time saved for plant owners by welders who use Tobin Bronze. These stories confirm the verdict of experienced welders that Tobin Bronze is a *better welding rod.*

For castings of such size and shape that furnace pre-heating is impossible, Tobin Bronze is often the *only answer.* Usually the fractured area is veed out; then *locally* pre-heated. Tobin Bronze makes an effective weld under conditions where ordinary cast-iron welding is impracticable.

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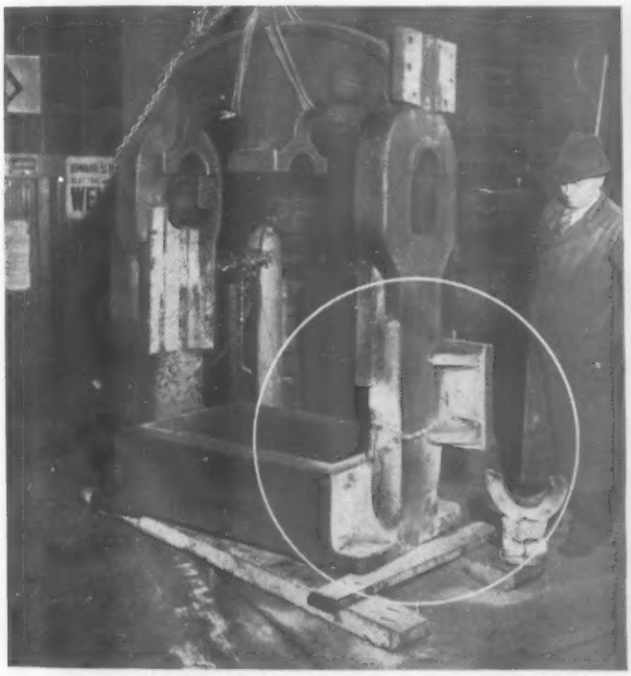
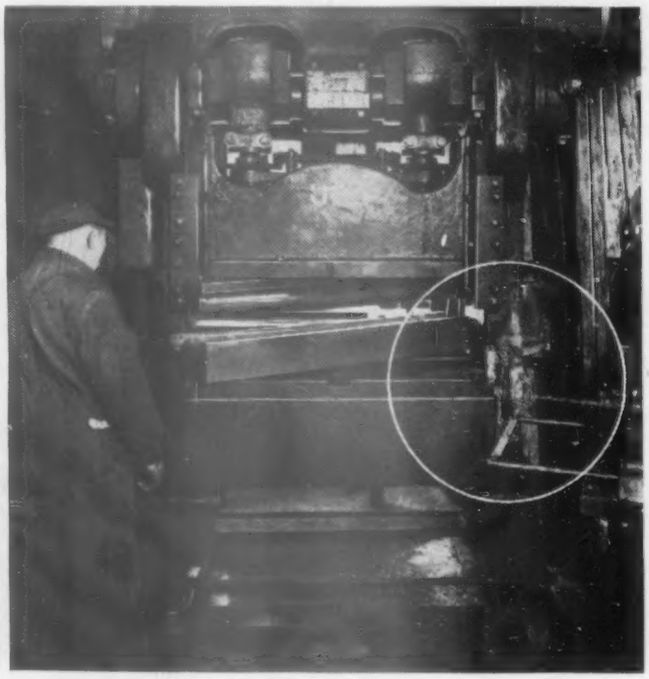
Make your place known as headquarters for Tobin Bronze welding. This time-tried Anaconda product makes highly satisfactory repairs at low cost. Each rod bears the trademark "Tobin Bronze Reg. U. S. Pat. Off." Look for it to make sure you are getting *genuine* Tobin Bronze. 37361





Another "busy season" breakdown repaired with Tobin Bronze

This press used in the manufacture of a glider-type porch swing broke at the peak of the manufacturing season. Here it is, repaired with Tobin Bronze and back at work again. The Hebeler Welding Company of Buffalo did this job. "We can't say enough good things about Tobin Bronze," says E. S. Hebeler.

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

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ture was supplemented with several interesting slides.

"Multilayer Welding," by A. N. KUGLER, Air Reduction Sales Co., and "Flame Hardening with the Oxy-Acetylene Process," by DR. GEO. V. SLOTTMAN, Air Reduction Sales Co., were scheduled for presentation at the November 15th meeting of the Philadelphia Section of the American Welding Society. The next meeting can Bridge Co., presented a sound motion picture on "The San Francisco-Oakland Bay Bridge". His pic- of the Philadelphia Section will be at the Engineers' Club, on January 17, 1938. "Electric Welding Progress," by J. F. LINCOLN, president, Lincoln Electric Co., will be the subject.

Trade News

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the appointment of ROBERT H. SCHUSTER to the sales staff of the Pittsburgh office, 926 Manchester Blvd., N.S., Pittsburgh, Pa. Mr. Schuster attended Washington and Jefferson College and for the past five years has been employed in sales work in the Pittsburgh district with the Ault & Wilborg Division of Inter-Chemical Corp. Mr. Schuster will be working under the direction of W. R. PERSONS, who was recently appointed district manager of the Pittsburgh office.

LINCOLN MAKES NEW MANAGER APPOINTMENTS

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the appointment of ARTHUR T. COX, JR., as manager of its Tri-Cities welding sales-engineering office, located at 1205-09 Fourth Ave., Moline, Ill., effective November 1. Mr. Cox formerly worked in the company's Chicago office and succeeds J. B. FLOCK, who is taking a year's leave of absence.

It is also announced that F. M. MAICHLE has been appointed manager of the Detroit office at 10228 Woodward Ave. Until his new appointment, Mr. Maichle was manager of the company's Pittsburgh office. He will be assisted by C. H. BUCKMASTER, J. F. CUNNINGHAM, N. B. GILLILAND, T. A. STEEL, and F. E. BOUCHER in providing a complete welding supply and consultation service.

Another Lincoln announcement: A new sales office has been opened in Phoenix, Ariz., in charge of R. J. REARDON. For the past six years, Mr. Reardon has been with the American Metal Products Company of Deroit as welding engineer and supervisor.

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the appointment of W. W. MCCLELLAN to the sales engineering staff of its Grand Rapids office, 314 Building and Loan building, Grand Rapids, Mich. Mr. McClellan attended East Grand Rapids High School and the Engineering School of Muskegon Junior College, Muskegon, Mich. His first mechanical experience following school was in the engine room of a Great Lakes freighter. He has had extensive practical welding experience, having been engaged in maintenance welding for the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., as general welder for the E. W. Bliss Co., manufacturers of punch presses, at Hastings, Mich., and as a special welder working on jigs, fixtures, tools and dies in the tool and die department, Grand Rapids stamping division of General Motors Corp. This extensive experience in welding will enable Mr. McClellan to assist welding users in the vicinity of Grand Rapids, in applying the electric arc in manufacturing, construction and maintenance. Mr. McClellan will be under the direction of R. D. Layman, who is in charge of the Grand Rapids office.

OKOCORD

Extra Flexible

WELDING CABLE

● Okocord Welding Cable is extremely flexible, which tends to prevent the welder's wrist from tiring. This flexibility is obtained by using a great many fine copper wires in the strand.

These cables are protected from external abuse by a tough, tire tread type of 60% rubber jacket or sheath. This sheath is reinforced with embedded seine twine cords to withstand the tugging and yanking to which welding cables are subjected.

For long trouble-proof service, use Okocord.

THE OKONITE COMPANY

Founded 1878

and

HAZARD INSULATED WIRE WORKS DIVISION

THE OKONITE-CALLENDER CABLE COMPANY, INC.

EXECUTIVE OFFICE: PASSAIC, N. J.

New York, Philadelphia, Los Angeles, Boston, Pittsburgh, Seattle, Buffalo, Chicago, Washington, Dallas, Detroit, San Francisco, Atlanta

Factories: Passaic, N. J. Wilkes-Barre, Pa. Paterson, N. J.

A new organization, the ROBINSON WELDING SUPPLY CO., has been formed by J. M. ROBINSON who, for the past 12 years, has been Detroit district manager for The Lincoln Electric Co. This new service organization in Detroit, with warehousing facilities, will provide prompt supply service of arc welding machines, electrodes and accessories.

Mr. Robinson is a graduate in electrical engineering from Georgia

J. M. Robinson

Tech. During the time he has served Detroit welding users, he has made many friends. His extensive knowledge of arc welding combined with long experience assisting industrial firms in the application of the process in manufacturing, construction and maintenance, will be helpful in analyzing and filling the needs of customers.

The Robinson Welding Supply Co., will handle Lincoln Electric Co. products exclusively, including "Shield-Arc SAE" welders, electrodes and latest developments in arc welding accessories and supplies, together with "Linc-Weld" motors. The company will be located at 1921 E. Perry St., Detroit, Mich.

THE GENERAL WELDING & EQUIPMENT CO., 292 Main St., Cambridge, Mass., manufacturers of "Geweco" automatic shape cutting machines, announces that its sole distributor in the Chicago and Milwaukee territories is MACHINERY & WELDER CORP. The Chicago office is located at 312 North Loomis St. and the Milwaukee office at 513 East Buffalo St. The head office of Machinery & Welder Corp. is in St. Louis and this company is already acting as distributor of Geweco flame-cutting equipment from its St. Louis, Kansas City and Moline branches.

THE WILL-WELD SALES CO. of Chicago, Ill., handling Will-Weld impedance control welders, announces the removal of its office from 11125 S. Vincennes Ave. to 2139 So. Wabash Ave.

H. S. SCHULER has been appointed division manager of industry advertising of the Westinghouse Electric & Manufacturing Co., it is announced by J. M. MCKIBBEN, sales promotion and apparatus advertising manager. Other division advertising managers appointed by Mr. McKibbin are T. H. CABLE and J. H. THOMPSON.

THE HARNISCHFEGER CORP., Milwaukee, Wis., announces the appointment of ALLIED EQUIPMENT CO., 1639 W. Main St., Oklahoma City, Okla., as agents for the complete line of P & H-Hansen Smootharc welders and welding electrodes.

The Standard Asbestos Manufacturing and Insulating Co. are also appointed agents, with a general office and factory in Kansas City, Mo. In addition they have complete office and warehouse facilities in Tulsa and Oklahoma City, Okla., and also in Borger, Tex.

ADAMS
VERTICAL WELDERS

Modern as Stream-lined Trains *and* Sky-Sleeper Airplanes

Developments in the arc welding field move swiftly. The arc-welder which you chose as best but a year or two ago has been outmoded by machines of increased capacity and greater versatility.

We refer, of course, to the new Adams Vertical Welders — modern marvels of smooth operation which readily adapt themselves to a wide variety of jobs. Write us concerning your welding requirements and let us arrange for a demonstration and test on your own work.

Adams Vertical Welders are offered in D.C. and A.C. models in several sizes. The Adams line also includes engine-driven welders, generators, welding supplies, and a complete assortment of electrodes for mild steel, stainless steel, manganese steel and aluminum.

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J. D. ADAMS COMPANY - INDIANAPOLIS, IND.

WELDING DIVISION

H. S. REIZENSTEIN has been appointed contract manager of the Westinghouse Electric International Company. A graduate in electrical engineering and business administration at the University of Pittsburgh, Mr. Reizenstein entered the Westinghouse Company in 1910. He will make his headquarters at 150 Broadway, New York.

G. BLOCKSIDGE has been appointed assistant to vice president of the Westinghouse Electric International Company. Mr. Blocksidge became associated with Westinghouse in 1906 following his graduation in electrical engineering from the Virginia Polytechnic Institute. Mr. Blocksidge will handle all contracts with the Electrical Apparatus Export Association and similar associations, together with other special assignments, and will make his headquarters at 150 Broadway, New York.

D. C. BROOKS has been appointed sales promotion manager of the Westinghouse Electric International Company. Mr. Brooks was educated in England, and in 1928 entered the Merchandising Division of Westinghouse in this country. He will make his headquarters at 150 Broadway, New York.

THE PHILLIPS & EASTON SUPPLY CO., of Wichita, Kan., distributors of Lincoln Electric Welding Equipment in the Central Kansas territory, sponsored a two-day electric welding school on September 29 and 30 at Wichita. Over 200 men registered.

WALLACE L. COOK has been appointed director of personnel and LAWRENCE G. ANDREWS, assistant director of personnel, for the Chicago district of Carnegie-Illinois Steel Corp. MR. COOK is a graduate of Cornell and received his master's degree at Yale. He has been connected with the Carnegie-Illinois industrial relations division since June 1, 1936. Upon graduating from Ohio State, MR. ANDREWS received a scholarship from the bureau of personnel research at Carnegie Institute of Technology. He has been assistant superintendent of industrial relations at South works of Carnegie-Illinois since January, 1936.

Trade Literature

A new book describing the Hansen Smootharc welder has recently been written by F. J. HIRNER, welder division, the Harnischfeger Corp., Milwaukee, Wis. The differences between separate and self-excited generators as well as the characteristics of external and internal stabilization are described with the help of curves, photographs and diagrams. Also described are single-current control as compared with double manual control. Copies of this book may be obtained by writing the Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.

ARCOS CORP., 401 N. Broad St., Philadelphia, Pa., has issued a new technical bulletin entitled "The Arc Welding of Stainless Steel Industrial Equipment." This bulletin includes information of value to welding engineers, designers, operators and metallurgists on the problems encountered in the arc welded fabrication of the straight chromium and the chromium-nickel alloys. Under their own headings it covers the 2% and 4-6% chromium as well as the 16% and 18% straight chromium alloys. The austenitic series covered includes the 18-8, 25-12, 25-20 and higher chrome-nickel alloys. An article covers welding technique which is of particular interest to the operator. It also contains an article on the testing of stainless steel welds for corrosion. Copies may be obtained by writing to the company at the above address.

HOBART BROTHERS, Troy, Ohio, have just issued a new folder "Building Your Own," which describes how to build the Hobart simplified arc welder at a substantial saving in cost. The claim is made that a welding shop cannot afford to pass up big welding profits when the equipment can be built at a substantial saving.

THE OKONITE CO., Passaic, N. J., has just completed a new two-reel sound film showing how rubber-insulated wires and cables are made and used. Lowell Thomas is the narrator. It will be shown without charge in 16mm. and 35mm. sizes to those interested in this subject.

A BOOKLET ON STAINLESS STEEL electrodes, containing considerable information regarding the various grades of stainless steels and the procedure for welding them, has just been published by the Page Steel and Wire Division of American Chain & Cable Co., Inc., Monessen, Pa. A copy will be sent on request.

METALSPRAY COMPANY, 113 Llewellyn St., Los Angeles, Calif., has just issued "Bulletin 800," which describes some of the new applications in metal spraying. Quite a wide variety of applications are illustrated and briefly described, most of which involve new methods. Complete records of procedures and costs are available and the company will send further details concerning any of the subjects illustrated to anyone interested.

THE ACETYLENE & WELDING CONSULTING BUREAU, LTD., London, England, has just published a revised edition of "Acetylene Flames." The first edition was issued three years ago and has now been entirely revised and brought up to date. The publication does not pretend to be a text book, but is primarily intended to interest users and prospective users of the oxy-acetylene process.

Ryerson a dependable source for Welding Rod

● Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

Ryerson
Shielded Arc Type No. 215
Shielded Arc Type No. 216
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Copper Coated No. 206
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Cast Iron

ELECTRODES

Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux Coated
Blue Flux Coated

GAS RODS
3½% Nickel Steel
High Carbon Bare No. 2110

Ryerson
3½% Nickel Steel Flux Coated
High Manganese Steel Hard Surfacing
Allegheny Stainless Flux Coated
Allegheny Stainless No. 44
Tobin Bronze
Allegheny Stainless Bare Hard Filler

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

THE INDUSTRIAL GLOVES COMPANY, 750 Garfield Boul., Danville, Ill., has just published a new catalog of "Steel-Grip" safety apparel, illustrating widely used hand and body guards for the prevention of injuries. This company manufactures more than 3,000 individually designed types of gloves, mittens, hand leathers, arm protectors, sleeves, aprons, chaps, leggings, shin guards, spats, coats, pants, and fire-fighting suits from high quality chrome leather, asbestos and fireproofed duck materials. The catalog is replete with dozens of new clothing safeguards for industrial use. Copies will be furnished upon request.

"ARC WELDING with the New 40-Volt Simplified Arc Welder," is the title of a new catalog just issued by Hobart Bros., Troy, Ohio. It shows the uses of Hobart's new motor horsepower control that lets the operator use half the horsepower of a normal welder on light work and full horsepower on heavy work with a substantial saving in current costs. The center spread of the catalogue shows interesting details of the internal construction. Copies of the catalogue will be sent to any one interested.

"THE HAYNES STELLITE LIBRARY," a useful booklet just published by Haynes Stellite Co. Kokomo, Ind., lists and briefly describes 18 Haynes Stellite books, reprints, and folders dealing with hard-facing alloys, cutting tools, and alloys for chemical processing equipment. This literature is summarized and grouped under four sections: "For the Machinist," "For General Maintenance," "For the Welder," and "For the Metallurgist." A convenient form on the back page, when filled in, torn out, and sent to the nearest Haynes Stellite office will bring, by return mail, any of the publications listed.

"MANGANAL 11 TO 13½% NICKEL MANGANESE STEEL" is the subject of a booklet just issued by Stulz-Sickles Co., 91 New Jersey Railroad Ave., Newark, N. J. This new catalog describes bare and "Tite-Kote" welding electrodes, applicator bars, wedge bars and forged wedges.

DRAVO CORP., 302 Penn Ave., Pittsburgh, Pa., have issued a new catalog describing their Lee direct-fired unit heater for installation in warehouses, factories, garages, etc., where an easily controlled economical source of heat is required to prevent freezing or to increase plant efficiency during the winter months. Copies can be obtained by addressing the company.

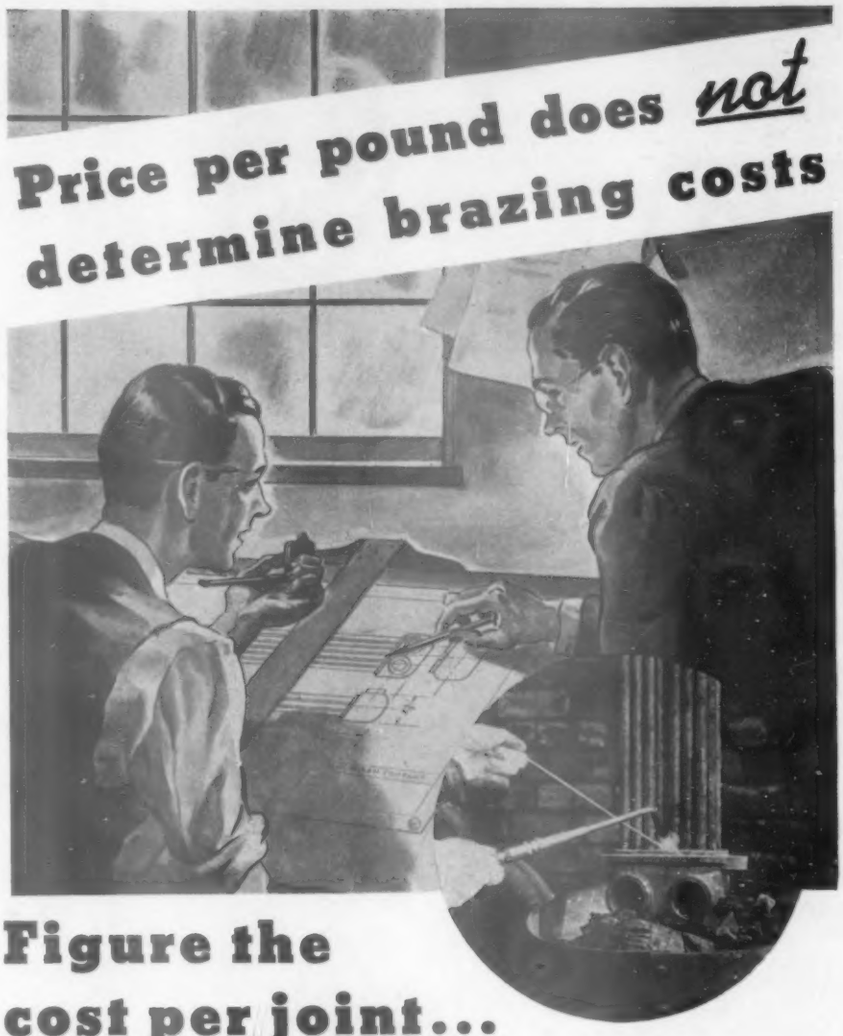


Figure the cost per joint...

Alloy cost is frequently the least important item—small in relation to labor and gas.

The low temperature brazing alloys SIL-FOS and EASY-FLO help to reduce labor costs. They both flow freely at low temperatures (1300° F. and 1175° F.) and penetrate quickly and deeply compared to base metal brazing rods. They make brazing an easier, quicker operation. A thin film of alloy flows readily between closely fitted parts and keeps the alloy cost per joint low. With little or no alloy left outside the joint after brazing, finishing costs are reduced.

If you are not using low temperature brazing try it — use SIL-FOS with non-ferrous metals and EASY-FLO for joining ferrous metals and the many chrome-nickel and copper-nickel alloys. The low working temperatures of SIL-FOS and EASY-FLO avoid the higher heats where physical qualities of some metals are damaged.

Write us for details about LOW TEMPERATURE BRAZING.

HANDY AND HARMAN · 82 Fulton St., New York
BRIDGEPORT, CONN. PROVIDENCE, R. I. TORONTO, CANADA

THE FIBRE-METAL PRODUCTS CO., Chester, Pa., has issued a new catalog describing its complete line of welding accessories. Included in its 44 pages are a complete line of welding helmets, hand shields, chrome leather helmets, welder's electrode carriers and fireproofed caps. Also, included in this catalog is information about cover and filter glass, sterilizing of welding helmets, babbitting and face masks for other purposes than welding. Copy of this catalog will be sent upon request.

"PREVENTING WELDING AND CUTTING FIRES," a new booklet just published, should be useful to all those interested in welding or cutting operations. The booklet is an important part of the nation-wide program to promote safe practices among the users of industrial equipment. It includes safe and sure rules to follow for preventing the possibility of welding or cutting fires, as well as other pertinent information. Copies of this useful booklet may be obtained free upon request to any office of The Linde Air Products Co., New York and principal cities.

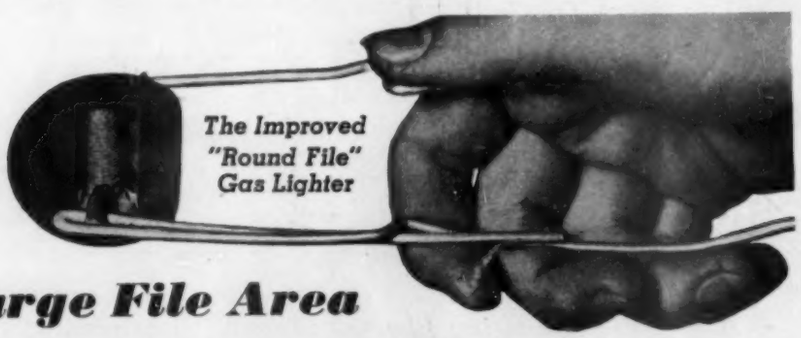
THE METALLIZING PROCESS, a new booklet, issued by Union Metallurgique, 2 Blvd. de la Porte-Haute, Mulhouse, France, describes in much detail the metallizing apparatus of their manufacture, together with operating data and descriptions of application.

HARD-FACING BOOKLET—A revised edition of the booklet, "Haynes Stellite Products in the Oil Fields," has recently been published by Haynes Stellite Co., unit of Union Carbide and Carbon Corp. The new edition describes in detail the complete procedure for hard-facing and hard-setting oil well bits with Haystellite, the cast tungsten-carbide diamond substitute. It also presents many examples of the performance of bits hard-faced and hard-set with Haystellite. Recent additions to the booklet include a section on Haynes Stellite —-Metal cutting tools, giving the specifications of these tools, as well as briefly describing recommended practices for using them, and a new section devoted to the corrosion-resistant Haystelloy alloys. Copies of this booklet can be obtained without cost or obligation upon request to any Haynes Stellite district office or to the general office in Kokomo, Ind.

"THE WORKING OF SILCROME STAINLESS STEEL," a new technical publication by Ludlum Steel Co., Watervliet, N. Y., links up, in a novel way, detailed instructions on methods of fabricating Ludlum Stainless with information as to the grades of tool steel best suited to each operation.

This factual data book has been prepared for the use of engineers, designers, and other technical men interested in practical working methods, to guide them in using Silcrome to greatest advantage. It contains practical advice on all the usual metal working operations, such as sawing, drilling, milling, threading, tapping; also on hot upsetting and forging, shearing, drawing, punching, spinning, brazing, soldering, welding, and the like. In addition, the book contains information on the proper selection, heat treatment, etc., of the tool steels for various operations.

This manual, according to Ludlum, is the outgrowth of long experimentation in the laboratory, and careful study of actual production methods.



Large File Area

The "Round File" construction provides a very large file area—approximately one square inch. This assures longer life for the lighter. The file is of superior quality and can be easily replaced.

Many superior design and construction features combine to make the Improved "Round File" the most economical and efficient lighter on the market.

Get acquainted with Improved "Round File" and its many advantages. Descriptive folder and prices on request.

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

Job Welding

THE SUPERIOR WELDING SHOP, Salina, Kan., operated by E. Constable, Stellited over 1500 plow shares this past summer and fall. Aside from putting out a first class job, Mr. Constable says this volume was attained by a small amount of newspaper and radio advertising.

UNIQUE IN ITS LOCATION, a welding service has been inaugurated in a trailer camp at 2300 Nadeau Ave., Huntington Park, Calif., by Frank Turner. Beside his oxy-acetylene equipment, Mr. Turner has a light portable electric welder. He specializes in chassis work and trailer hitches.

R. G. DUNLAP, operating a job welding and oil well digging bit service shop in Bakersfield, Calif., recently opened a branch shop at 3249 Cherry Ave., Signal Hill, formerly the location of the Long Beach Boiler Works.

GEO. C. CHRISTOPHER & SONS IRON WORKS, Wichita, Kan., have two jobs going through the shops. One job comprises 55 special butane tanks ranging in size from 250 to 600 gallons; the other job comprises seven 42-in. smokestacks, approximating 50 ft. in height.

FARLEY MACHINE WORKS CO., Burrton, Kan.—Three special friction type Gephart sand reels used in oil drilling operations are now being fabricated for shipment to Burma, India. Considerable welding is involved.

THE HOLZEMER BOILER & WELDING WORKS, McPherson, Kan., have opened a new oil field boiler and welding shop near Susank, Kan., with Russell Overly in charge.

Obituary

D. D. WACHTER, sales manager of Arcos Coporation, died very suddenly from gasoline burns on Ocober 5th at Taylor, Pa. All of Mr. Wachter's personal and business friends are saddened by this loss.